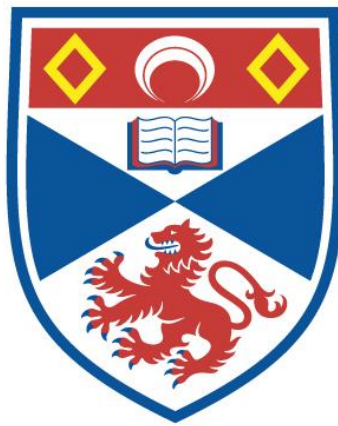


COMPETITION, PROFITABILITY AND RISK IN US BANKING

Fiona Jayne McMillan

**A Thesis Submitted for the Degree of PhD
at the
University of St Andrews**



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Competition, Profitability and Risk in US Banking

Fiona Jayne McMillan



This thesis is submitted in fulfilment for the degree of PhD
at the University of St Andrews

May 2014

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Abstract

This thesis is concerned with the relationships between profit, profit persistence, risk and competition within the US commercial bank sector. In particular, the thesis asks three questions: how profit and profit persistence are affected by changes in regulation designed to enhance competition; how profit persistence varies over time according to changes in market and economic conditions; how different aspects of banks' risk is affected by competition and market structure. Understanding the nature of these relationships is important given the prominent role banks play in the allocation of resources, the provision of capital to the economy and the stability of the financial system. Moreover, these roles in turn, have an effect on bank performance and wider economic growth and stability. Such issues have especially come to prominence following the financial crisis and thus there is a need for empirical evidence on which to base policy.

To examine these relationships the thesis implements panel estimation techniques and obtains data on all commercial banks, primarily over the period 1984-2009, thus including births and deaths. The key findings show, first, that profit persistence is relatively low compared to previous US banking studies and compared to manufacturing firms. Moreover, persistence varies with regulatory changes, although not always in the expected direction, notably the increase in persistence following the 1999 Gramm-Leach-Bliley Act. Second, additional time-variation in persistence is linked to bank specific, market structure and economic factors. Notably, persistence varies with bank size and market share, market concentration and output growth, but the precise nature of these relationships varies across the sample and by bank size. Third, that there is a difference in the nature of the relationship between competition and loan risk on the one hand and competition and total risk and leverage on the other. We also find that the relationship between risk and market structure varies according to bank size and that the economic cycle influences banks' risk.

The implications and contribution of this thesis lie in establishing empirical evidence for understanding the nature of the relationships between competition, profits and risk. This is particularly prescient given the move towards new regulation following the financial crisis. Key results here show that no simple relationship exists between bank size or market concentration and competition and risk, therefore policy should account for such differences, whether according to bank size or type of risk.

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Chapter 1. Introduction.

1.1. Background to the thesis.

Understanding the nature of competition and risk in banking is important given the prominent role banks play in the allocation of resources, the provision of capital to the economy and the stability of the financial system. Moreover, these roles in turn, have an effect on bank performance and wider economic growth and stability. This thesis examines the dynamics of profitability and risk of US commercial banks over the period 1984-2009. This is a period marked by notable changes within the banking industry, both in terms of deregulation and technological advances. Geographical deregulation occurred via the 1994 Reigle-Neal Interstate Banking and Branching Efficiency Act, which repealed geographical banking restrictions imposed via the McFadden Act of 1927. As such, banks were able to enter into other states without permission leading to a convergence in banking regulations. Product deregulation was codified via the 1999 Gramm-Leach-Bliley Financial Services Modernisation Act, which repealed the Glass-Steagall Act (1933) and permitted Financial Holding Companies (FHCs) to own affiliates engaged in banking, insurance underwriting and securities activities. As a result, the separation between commercial and investment banking became less distinct and traditional investment banks became increasingly involved in commercial lending. The effect of such deregulation has been a drastic change in the structure of the US banking industry as commercial banks have grown rapidly. Alongside this, the number of commercial banks in the US has been halved, while the number of branches has more than doubled.

Technological advances via process innovations such as the creation of the automated teller machine (ATM) and internet banking has also increased bank efficiency and reduced the cost of producing banking services by diminishing the importance of geography for banks and customers. Product innovations such as the creation of the money market mutual fund (MMMF) made investments more accessible to the average household as they transformed large-denomination money market instruments (commercial paper, negotiable CDs and Treasury securities) into smaller denomination investments. The process of securitised lending has had a significant impact on the structure and performance of the US banking industry, whereby banks originate loans but do not finance them. Banks which use this lending technology have benefited from large production and financing efficiencies. Furthermore, small businesses and households have had access to credit which would otherwise have been unavailable to them. However, the global financial crisis which started in 2007 is closely tied to the failings of this lending technology. That is, as the US housing market collapsed, large numbers of home owners began defaulting on their mortgage loans, of which most of these were subprime loans. Such loans, to substandard borrowers, were produced using the originate-to-sell transactions lending model that large retail and investment banks had adopted during the 1990s and 2000s. Subprime loans were a significant factor in the growth of these banks and as their value dramatically declined so too did the value of the securities backed by them. Banks and other financial institutions thus incurred large losses which precipitated a wave of bank failures and a massive decline in overall industry earnings over the following two years.

Overall, deregulation and technological advances had a dramatic impact on the economics of the US banking industry. The largest US banks dramatically increased in

size following deregulation and now compete on a global scale. The number of banks has significantly reduced in response to the changing environment, while the number of branches has drastically increased. Banks have become more diversified in the products and services they offer and consequently, the industry has experienced a decrease in the proportion of revenue generated from traditional interest-based income while fee-based income has increased. This is mostly driven by larger banks, as they generate a greater proportion of their revenue from non-interest income than smaller banks. Ultimately, these changes have transformed the structure, conduct, performance and risk of the US banking industry.

1.2. Aims, Hypotheses, Methods and Key Findings

This thesis examines two key issues. First, the thesis assesses the impact of major regulatory changes on competition through modelling the dynamics of bank profit and the persistence of profit. In particular, profit persistence provides a proxy for the degree of competitive pressures such that where the degree of competition is high then abnormal profits would be eroded quickly. The presence of persistence in (abnormal) profits is an indication of the existence of impediments to competition. Therefore, we examine how regulation has affected the degree of profit persistence. In particular, where regulatory changes were designed to enhance competition we would expect such persistence to decline. In a related exercise, we then extend the analysis to consider whether persistence varies more generally over time and hence relax the usual assumption that holds persistence fixed. Thus, we also trace the dynamics of profit persistence over time in order to examine how competition has evolved and those

factors that are linked to change in profit persistence. It is our belief that due to the continued nature of product innovation there will be changes in market structure and the degree of competition and hence the persistence of profits. As such, profit persistence is likely to change over time and thus this time-variation will be linked to a variety of factors arising from market structure, bank characteristics and even more general economic conditions.

The second main research question considered within this thesis is the determinants of bank risk. Notably, we can examine different aspects of bank risk, such as loan portfolio risk and overall risk, and examine how market structure (and from that we can infer the degree of competition) affects the level of risk. Thus, the analysis of risk can be couched in terms of the debate between the competing competition-stability and competition-fragility hypotheses. Furthermore, we can examine whether the relationship between risk and competition differs across different types of bank, for example whether large banks differ from smaller banks. Such an examination may be of interest given the recent debate regarding the level of risk within large banks. The overriding view is that bank risk is related to market structure (and hence competition), however, the nature of that relationship is unclear from the existing literature. That is, whether increased competition leads to a more stable banking system because large banks that exert market power are able to charge higher rates on loans, which may in turn increase the risk of default on those loans (competition-stability). However, there also exists an alternate view, whereby more concentrated banking systems are more robust to shocks, notably as large banks are able to diversify their income streams and build up greater capital buffers (competition-fragility). We aim to examine this issue here.

This thesis sets out several research questions: considering how acts of deregulation affect competition through the persistence of (abnormal) profit; whether such persistence is more generally time-varying and whether that time-variation is linked to explicit factors; what is the nature of the relationship between competition (market structure) and bank risk. More specifically, we consider research questions that ask whether banks' profits exhibit persistence and thus indicate a degree of hindrance to the competitive process. Related, we wish to consider whether deregulation affects the degree of profit persistence and thus, whether such Acts designed to enhance competition have the desired effect as proxied by persistence. More generally, we seek to consider whether persistence exhibits a greater degree of time-variation than just that attributed to deregulation. That is, given the amount of technological and other change within the banking sector, our contention is that persistence may exhibit more frequent changes rather than just discrete shifts. While these research questions consider the relationship between competition and profits, we also seek to examine the relationship between competition and risk. Therefore, we ask whether market structure impacts upon risk and thus whether we can provide evidence for the competition-stability or competition-fragility view. In doing so, we consider different aspects of the relationship, including, for example, different measures of risk (such as loan portfolio risk or total risk) and different segments of the banking market (such as separating banks by size). In examining these research questions we build a panel of data on US commercial banks over the period 1984-2009.¹ The data is analysed largely using a

¹ We obtain data from 1976 to 2009; however, some key variables are only available from 1984. Therefore, estimations take place over the shorter sample, except where noted in Chapter 5 as the longer sample is preferred when considering time-variation. Several figures also include the full data where appropriate and it is noted.

fixed effects panel approach, while alternative GMM (generalised method of moments) are used to ensure robustness of the results to potential endogeneity issues.

The results in the thesis suggest the following. First, regarding profit persistence, the autoregressive parameter is statistically significant, suggesting that profits do exhibit some persistence such that the competitive process does not act unimpeded. Second, with respect to the effects of deregulation, the impact on persistence differs. That is, while both the Acts considered were designed to increase competition and hence should decrease persistence, the effect on persistence is not ubiquitously downward. The results show that following the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act that allowed for interstate banking, profit persistence did indeed decline. This is consistent with the view that this Act enhanced competition by allowing efficient banks to move in to areas previously occupied by less efficient banks that were previously protected from competition. However, with regard to the 1999 Gramm-Leach-Bliley Act profit persistence increased. While at face value this might suggest that competitive pressures had eased following the Act, an alternative interpretation would be that banks were able to diversify their activities following the Act and thus were able to protect their profits, hence leading to an increase in persistence.

Third, we reveal evidence that profit persistence is time-varying in addition to changes surrounding deregulatory acts. Using a series of fixed and expanding window regressions we are able to show that persistence declines in the late 1980s and rises in the late 1990s/early 2000 before falling during the financial crisis period. Using these regressions, as well as a sequence of threshold-type regression,s we are further able to confirm the presence of time-variation. Fourth, we consider what factors may affect such time-variation. Our analysis suggests two key results. First, that the time-variation

is related to bank specific factors, market structure factors and economic factors. Second, that there is noticeable time-variation within the effect of these different factors on persistence. Furthermore, that both of these conclusions hold in the regression for all banks, as well as the regression organised by bank size.

The final set of results considers the relationship between bank risk and competition and in doing so, considers the competition-fragility versus competition-stability hypotheses. The results here suggest that there is a difference in the nature of the relationships between loan risk and other measures of risk. Specifically, the results for loan risk appear to support competition-stability hypothesis, whereby increased competition leads to a lower level of non-performing loans. In contrast, increased competition leads to lower Z score values (greater risk) and lower equity-to-asset ratios. This appears to suggest that banks view the risks associated with different aspects of bank behaviour differently. Hence, while increased market concentration may lead to greater credit-risk taking behaviour, it leads to lower overall risk and higher capital buffers. The results here also suggest a difference between large banks and other-sized banks, with large bank risk exhibiting a weaker relationship with market structure but a stronger relationship with the economic cycle.

1.3. Contributions

The contribution to the literature can be described as follows. The thesis embarks on a large scale exercise examining the relationship between competition, profit persistence, deregulation and bank risk over a longer time series than typically considered and using a data set comprising of all commercial banks that existed over the sample period.

Thus, the sample of banks includes those that enter and exit, as opposed to studies that only including living entities. It is hoped that such a large sample should provide robust results. In terms of the specific results, the thesis reports on how the Acts of deregulation affected profit persistence and thus the competitive process. In particular, it is important to note that although the two acts considered were designed to enhance competition, they had opposite effects on persistence, with the first Act (1994) reducing persistence and the second Act (1999) leading to an increase in persistence. Thus, it is important to recognise that the outcome of such deregulatory acts may not be as intended and this can have implication for future regulation.

This thesis also presents evidence of time-variation within profit persistence that has not previously been considered. That is, by relaxing the unrealistic assumption of a constant persistence parameter, especially when considered over a time series of more than twenty years, this thesis shows that persistence is related to a range of factors including bank specific, market structure and economic cycle ones. Again, these results are important, not only for recognising the presence of such time-variation, but also in a policy context for understanding whether there exists a relationship between bank size and market share for example, or market concentration and competition as proxied by persistence.

Finally, this thesis contributes to the literature on bank risk and market structure and the debate regarding the applicability of the competition-fragility versus the competition-stability hypotheses. In particular, the results here confirm that there is a distinction to be made between different parts of a bank's activity. That is, the relationship between risk and competition differs across an analysis of a bank's overall risk or a bank's loan portfolio risk; with increased competition increasing the former

risk and reducing the latter risk. This again has implications for the conduct of regulatory policy. Furthermore, our results show a difference between large banks, whose risk is less affected by market structure, and other sized banks. Again, this can feed in to the policy debate about bank market structure and bank size.

1.4. Structure Outline

The rest of this thesis is structured as follows. Chapter 2 provides an overview of the key regulatory and structural changes that have occurred within the US banking sector, with our main focus on commercial banks. Particular emphasis is given to the legislation implemented in response to the Great Depression in the 1930s and the ensuing removal of these regulations in the latter part of the 20th Century.

Chapter 3 considers the two main approaches that exist within the large body of literature that examines the microeconomics of competition in banking; that is the Structure Conduct Performance (SCP) paradigm, with its revisionist/Chicago critique, and the New Empirical Industrial Organisation (NEIO) approach. In addition, further literature related to competition in banking, including for example, conjectural variations Cournot models and structural demand models, is also considered.

Chapter 4 seeks to examine the degree of profits persistence in US commercial banks and the effects on persistence of regulatory changes largely designed to increase competition and thus lower persistence. Furthermore, we provide a preliminary look at the effects of the liquidity crisis that began in 2007 on persistence. This chapter contributes to the existing literature by not only examining a larger dataset than previously considered, both in the time and cross-sectional dimension, but also by

explicitly incorporating key changes in the modelling which allows us to comment on the effectiveness of the legislation. Using a panel model approach to examine the persistence of US commercial bank profits, this chapter will attempt to examine how persistence has changed following two major pieces of regulatory change in the US banking sector, namely the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act and the 1999 Gramm-Leach-Bliley Act. In summary of the results, this chapter reports the following key findings. First, the general level of persistence in profit is relatively low, more so than that reported for manufacturing firms and as previously reported for US banks by Goddard et al. (2011). Second, the degree of profit persistence fell following the passage of the Interstate Banking Act of 1994, which may be indicative of an increase in competition arising from cross-state activity. Third, profit persistence increases following the 1999 Gramm-Leach-Bliley Act, which allowed banks to diversify into non-traditional banking activities. While the Act did not necessarily reduce competition, it did allow banks alternative sources from which to generate income and hence diversify their activities. Finally, persistence declined following the financial crisis that began in 2007, when US home prices began a sharp decline and an unusually large number of mainly subprime mortgages were defaulted on. Trillions of dollars of securities backed by these subprime loans suffered a fall in value and as a result imposed large losses on the portfolios of banks and other financial institutions that held them. In addition, industry earnings in 2008 and 2009 had fallen to around zero.

Chapter 5 seeks to examine whether there is time variation in the persistence of profit parameter, in contrast to the vast majority of studies which assume that the persistence parameter remains constant over the full time series period. This contributes

to the literature as, with the exception of the previous chapter, there has been no previous attempt to examine time-variation within the persistence of US bank profits. Furthermore, we seek to examine whether any time variation is linked to bank specific, market, or economic factors; and whether the nature of the relationship of persistence with these factors is itself time-varying.

Chapter 6 seeks to add to the literature on competition and bank risk, by building on the work of Berger et al. (2009) which examined the cross-sectional relationship between market structure and bank risk-taking for a range of countries. The authors used a panel structure for US banks in order to analyse this relationship. In particular, we consider three measures of risk; loan-risk, total risk and the equity buffer and examine the relationship of each measure with market structure, while controlling for certain bank-specific characteristics. Having examined this relationship for all banks, we further consider whether the risk characteristic differs between banks of different size, or banks that are performing above or below the average. Furthermore, in the model employed in this chapter we attempt to examine the impact of a key regulatory change, namely the 1999 Financial Modernisation Act, on banks' risk-taking behaviour. Within the banking literature, this has emerged as an important policy-debate as researchers seek to determine whether this Act, and thus the effective repeal of the Glass-Steagall Act of 1933, has increased banks' risk. In preview of the results, our findings indicate that there is a difference in the nature of the relationships between loan-risk and other measures of risk. Furthermore, there also appears to be a distinction between small and medium sized banks on the one hand, and large banks on the other. Finally, a further examination of bank risk behaviour according to whether the bank exhibited above or below profits, or whether the bank exhibited positive or negative

growth, reveals less of a difference between banks. However, across all categories of banks, GDP growth was found to be an important factor.

Chapter 7 concludes by summarising the main results. We also put forward some potential future research questions. Of particular note, our results reveal that the effects of two acts of deregulation on profit persistence (competition) are opposite. It is worthy of further research to consider this further and examine how similar deregulatory events have affected persistence in different markets. This thesis marks the first attempt to examine time-variation in persistence, with the results revealing such time-variation. Future research could be conducted towards establishing a body of evidence with regard to whether persistence is universally time-varying and the cause of the variation. Finally, the relationship between bank risk and competition remains an open question and in particular with regard to how competition affects the risk of different parts of a bank's business. Our results demonstrate a difference between loan portfolio risk and overall risk, an examination of different aspects of bank behaviour would be interest.

Chapter 2. Overview of US Banking.

2.1. Introduction.

The US banking system is distinctly different from banking structures found in other western economies, attributable to the unique manner in which the central bank and bank supervisory functions have evolved in the US. Historically, the US banking industry has been subject to extensive government legislation, in comparison with other industrialised nations. This includes regulations governing the prices banks can charge (i.e. interest rates), the activities they are permitted to engage in, the risks that they may take, the capital levels they are required to hold as well as the locations in which they may operate. Furthermore, macroeconomic shocks and competition have also acted as catalysts for regulatory change.

In response to the Great Depression, extensive regulatory policy governing US banking was first implemented throughout the 1930s. Further dramatic transformation of the banking industry has occurred following widespread deregulation over the course of the last few decades. As a result, the nature and composition of the banking industry changed significantly also. For instance, the number of commercial banks has halved as a result of thousands of mergers and acquisitions, while the largest banks have experienced a dramatic increase in size. Despite the trend of consolidation, when compared to other economies, the US banking system still comprises a relatively large number of banks. In contrast to most other western economies however, the banking system is not as highly concentrated.

Prior to deregulation, the growth of US banks was constrained for many decades, thus the top US banks have typically remained relatively small in comparison

to the largest European and Japanese banks. For instance, from the 1950s until the 1980s, the number of commercial banks in the US remained relatively stable at approximately 14000. Of these, more than 95 percent were community banks, i.e. commercial banks with assets of less than \$1 billion, and accounted for approximately one third of the industry's total assets. Following deregulation, by 2009 the number of commercial banks had fallen dramatically to just below 7000 banks. Banking and branching regulations protected commercial banks from large bank competition, thus giving small banks a competitive advantage in lending and deposit-taking at the local level. Following deregulation commercial banks grew rapidly, mostly as a result of mergers and acquisitions. DeYoung (2010) reports that on average, approximately 350 commercial banks were acquired each year during the 1980s. Throughout the 1990s approximately 500 commercial banks were acquired each year, while on average, roughly 300 commercial banks were acquired each year during the 2000s. Consequently, more than 10000 bank charters have been merged out of existence since the 1980s.

In addition to the increased merger and acquisition activity, the US banking sector also experienced a period of increased bank failures, thus contributing further to the decline in the number of commercial banks. The late-1980s to the mid-1990s witnessed the largest number of bank failures in the US since the Great Depression, totalling more than 1500. From 1970 onwards, bank mergers and failures have greatly reduced the number of US commercial banks; however, throughout this period a large number of banking charters have also been granted. Such a large volume of new bank start-ups or “de novo” banks is rare in other economies, and is the outcome of a system

whereby bank charters may be granted not only by the federal banking authority (OCC) but also by the 50 separate state banking authorities.

The decline in the number of commercial banks has been accompanied by a change in the size distribution of banks also. That is, the net reduction in the number of banks occurred wholly among small banks, via failures or mergers and acquisitions. In contrast, the number of very large banks has remained relatively stable.

During the 1970s, commercial banks were the main supplier of loans to US businesses. Carey et al. (1993), report that large commercial banks were the major source of both long-term and short-term financing to large businesses. DeYoung, Hunter and Udell (2004) report that the primary source of credit for small business enterprises came from smaller community banks. They find that during the 1970s, small community banks allocated between 20 and 30 percent of their loan portfolios to commercial lending.

Commercial banks were also the main providers of all basic financial products, excluding insurance products, required by the typical US household during the 1970s. Once again, due to technological constraints and the existing regulations, small commercial banks were able to compete with large commercial banks in providing most of these services.

In common with other industrialised nations, the US banking system also includes savings banks and thrifts (savings and loan associations), some of which are mutually owned, while others are stock banks. Their original function was to provide long-term residential mortgages (which still account for approximately 80% of their assets), funded by short-term savings deposits. However, regulatory changes in the

early 1980s permitted them to offer money market accounts, current or notice of withdrawal (NOW) accounts, flexible rate mortgages (in addition to the traditional fixed rate mortgages) and some commercial and personal loans. The Savings and Loans Crisis during the 1980s resulted in a dramatic reduction in the number of savings and thrift banks. Again, in common with commercial banks, numbers have continued to fall from more than 3500 to just over 1000 institutions.

Credit unions are another type of financial institution found in the US banking system. These institutions are owned by members including employees, police and fire associations, and teachers. Member salaries are paid into the credit union, thereby enabling basic deposit and loan facilities. Credit unions are exempt from income tax and therefore able to offer more attractive deposit and loans rates compared to commercial or savings banks. In 2009, credit unions in the US numbered just under 10000.

Following deregulation during the 1980s, more than 4000 new investment banks and securities firms were created. Just prior to the stock market crash in October 1987 there were approximately 9500 investment banks and securities firms. However, a combination of both the crash and higher capital requirements increased the number of mergers which therefore significantly increased concentration. For example, in 1987 the largest investment bank (Salomon's) had capital of \$3.21 billion, but a decade later, the largest bank (Merrill Lynch) had \$33 billion of capital.

Other types of financial institution found in the US include insurance firms and finance companies. Finance companies acquire loans from banks which are

subsequently used to fund short and long-term lending. The finance company sector experienced rapid growth following deregulation.

This chapter aims to provide an overview of the key regulatory and structural changes that have occurred within the US banking sector. Particular emphasis is given to the legislation imposed in response to the Great Depression in the 1930s and the subsequent removal of these regulations in the latter part of the 20th Century, with the main focus on commercial banks.

2.2. Historical Background

The First Bank of the United States was created in 1791 and operated until 1811. The war of 1812 and the resultant accumulation of federal debt prompted the creation of the Second Bank of the United States, which was chartered in 1816. This was met with strong opposition by many outside of the northeast who were opposed to a centrally controlled financial system, and subsequently the re-chartering of the Second Bank was vetoed in 1832. During the 1830s and 1840s, a number of states passed free banking statutes that spurred bank entry.

A number of Acts passed during the Civil War, including The National Banking Act of 1863, created a federal charter for banks. As a result, the dual banking system that exists in the US today originated, whereby commercial banks may operate under either a national bank charter or a state bank charter. Federal Law gives the Office of the Comptroller of the Currency (OCC), a bureau of the US Treasury Department, the authority to grant national bank charters and serve as the primary regulator and supervisor of national banks. State law gives each of the 50 state governments the

authority to grant state bank charters, and the banking commissions in each state share supervisory and regulatory authority over these banks with the Federal Deposit Insurance Corporation (FDIC) and the Federal Reserve (the Fed) (DeYoung, Banking in the United States).

Private clearinghouse systems were later developed in the nineteenth century in order to regulate bank activities and provide some forms of private sector monitoring. Following the Panic of 1907 and the collapse of the banking system, the Federal Reserve Act of 1913 was passed, which created a federally-chartered central bank and a system of regional Federal Reserve Banks (the Fed). The complex nature of bank supervision in the US has given rise to a large degree of overlap between supervisory authorities.

2.3. Overview of Key Regulations.

This section outlines the key regulatory changes that have occurred in the US banking sector. The five main areas of focus are restrictions on entry and geographic expansion; deposit insurance; product-line and activity restrictions; pricing restrictions and capital regulation.

2.3.1. Restrictions on entry and geographic expansion.

Much of the legislation designed to restrict the geographical expansion of banks originated during the period when the United States Constitution prohibited states from issuing fiat money and from taxing interstate commerce. In order to generate revenues

in light of this, states exerted their authority over banks to obtain fees for granting bank charters in addition to levying taxes on banks. Furthermore, states often owned or purchased shares in banks.

In order to establish a bank it was necessary to obtain a bank charter from the state government. States only received charter fees for banks incorporated in their own state and not for those incorporated in other states, thereby giving rise to the prohibition on interstate banking and the restriction of competition among banks. The 1927 McFadden Act granted states this regulatory authority over national bank's branching activities within their borders. While the Act did allow banks to enter other states by establishing multi-bank holding companies, most state governments typically did not grant the approval required to do so. In addition to the restrictions imposed on interstate banking, many states also imposed restrictions on intrastate banking by either granting charters for a specific location, or limiting the establishment of bank branches to a particular city or county. Again, the impact of this was to eliminate competition from out-of-state banks as well as from the branches of other banks within the same state. Unit banking laws were passed by some state governments, which prohibited banks from having any branches at all. From the 1930s to the 1970s, most states imposed partial or blanket restrictions on intrastate branching, in addition to the existing interstate restrictions.

While the 1927 McFadden Act permitted states to restrict branching of national banks, the Douglas Amendment to the 1956 Bank Holding Company (BHC) Act gave states the authority to restrict entry by out-of-state banks and holding companies. This act prohibited a BHC from acquiring banks outside the state where it was headquartered unless the target bank's state permitted such acquisitions. As most states did not grant

permission, the amendment effectively prevented interstate banking, thus putting an end to the practise adopted by many banks in an attempt to circumvent state branching restrictions, whereby multi-bank holding companies which operated in many states were formed

The process of repealing the prohibition on interstate banking began in 1978 when the state of Maine passed a law which stated that out-of-state BHCs would be authorised to enter the state (via the acquisition of existing banks, rather than by entering de novo), in exchange for reciprocal agreements by states that permitted entry by Maine banks. Alaska and New York were the first states to reciprocate in 1982, and by 1992 all states excluding Hawaii had passed similar laws. The Reigle-Neal Interstate Banking and Branching Efficiency Act of 1994 enabled banks and holding companies to enter other states without permission, thereby completing the transition to full interstate banking in the US. The only limit on inter-state expansion of commercial banking companies this Act imposed was that they were prohibited from acquiring other commercial banks should their percentage of the national deposit market exceed 10%.

The Reigle-Neal Interstate Banking and Branching Efficiency Act allowed all US banks to acquire banks in other states from September 1995. Furthermore, from June 1997 BHCs were allowed to convert subsidiaries into branches. State law still stipulated that they were only allowed to enter via acquisition rather than de novo branching, although in the case of a failed or failing bank, the FDIC has the authority to override these restrictions. Ultimate authority to regulate interstate bank acquisitions lies with The Federal Reserve. To prevent excessive concentration, a BHC or FHC is

prohibited from holding more than 30% of total deposits in any given state² and 10% of total deposits nationally. The Reigle-Neal Interstate Banking and Branching Efficiency Act made nationwide banking possible in the US for the first time in its history. Following the merger with Bank of America in 1998, Nationwide bank claimed to be America's first national bank with branches in 22 states and a share of total insured deposits approximating 8%.

A number of studies have sought to examine whether the Act conveyed any benefits, such as increased efficiency and lower costs, as a result of subsidiaries being converted to branches. Using a sample comprising BHC, Carrow and Heron (1998), report that the Act had a positive welfare effect. Jayaratne and Strahan (1997) demonstrate how those states that implemented the reciprocal regional agreements (1978-1992), which deregulated branching laws, experienced significant permanent increases in economic growth as a consequence. However, Freeman (2002) cautions that the Jayaratne and Strahan findings are over-estimated. Freeman argues that in the sample used by Jayaratne and Strahan, real incomes in the states that deregulated were on average 4% below trend, and recovered slowly. These states deregulated branching laws to encourage new bank entry because, as a result of poor economic conditions, their own state banks were underperforming or even failing. Freeman concluded that Riegle Neal therefore, did not have a powerful impact on growth rates. Nippani and Green (2002) examined the performance of banks in six different asset categories, both before and after the implementation of Riegle Neal. Performance was measured using variables including return on equity, return on assets, net interest margins and the ratio of non-performing loans to total loans. Their findings confirm that following the

² States can opt to waive the 30% limit

passage of the Reigle-Neal Act, the US banking sector experienced a significant increase in the degree of consolidation. However, a stronger macro-economy was largely responsible for the improvement in most performance measures, as demonstrated by the significance of real gross domestic product and the bank prime rate in the regression analyses undertaken by Nippani and Green (2002). Thus, the increase in consolidation and the accompanying reduction in competition that can potentially offset any efficiency gains, may account for the apparently small impact that the Act had on the economy and bank performance.

More recently, research has expanded to examine the impacts of the Reigle-Neal Act on the economy in general. Ho and Ishil (2011) argued that the Act lead to a subsequent increase in consumer welfare due to the changes in market structure that resulted. Notably, gains were highest where a larger number of banks located. Acharya et al (2011) suggested that as a result of the Act a reallocation of resources took place across sectors other than just banking. The results suggest that improved bank access effects were particularly evident in sectors characterised as having young, small and external-capital dependent firms. Amore et al (2013) and Cornaggia et al (2014) both examined the effect on innovation following the Act. Examining manufacturing firms, Amore et al argued that allowing interstate branching had significant beneficial effects on innovation activities, especially for external-capital dependent firms and firms located close to entering banks. Cornaggia et al report a similar result with small innovative firms dependent upon external funding benefitting from interstate branching. In slight contrast, Chava et al (2013) suggested the effect on innovation depended on local market conditions and whether deregulation led to an increase or decrease in local market power. Finally, Beck et al (2010) report that the effect of deregulation on the

distribution of income was too narrow that distribution particularly from the lower end, through increasing relative wage rates.

2.3.2. Deposit Insurance Legislation.

Federal deposit insurance was first introduced in 1933, in an attempt to restore confidence in the financial system. While the aim of insuring bank deposits was to reduce bank runs, this often led to banks undertaking greater risk also. For example, during the period 1907 to 1917, eight states introduced deposit insurance schemes which all subsequently collapsed during the 1920s as a result of banks engaging in excessive risk-taking behaviour (Calomiris and White, 2000). Between 1930 and 1980 deposit insurance coverage experienced a number of incremental increases. Since 1980 however, it has remained flat and thus inflation has reduced its real value by approximately 50 percent over the last few decades.

Some authors have argued that there is evidence to suggest that the branching restrictions outlined above have led to reduced risk-taking, which has increased stability and therefore reduced the need for deposit insurance. For instance, examining data from the 19th Century during which period private banks issued currency, Gorton (1996), provides evidence that notes in circulation which were issued by new banks from branch banking states were discounted substantially less than notes issued by banks from unit banking states. Calomiris (1993) reports that states with branch banking held both lower reserves and bank capital. Furthermore, he finds that bank failure rates in Arizona, Mississippi and South Carolina (states that permitted branching

but were affected by the 1920s agricultural bust) were lower for banks with branches than for those without.

There is limited evidence to suggest that small and rural banks supported both restrictions on bank branching (in order to reduce competitive pressures from large banks) and deposit insurance (in order to increase deposit supply). In contrast, large and urban banks generally favoured branch banking in order to compete with small banks directly and thus opposed deposit insurance as a subsidy to small, poorly diversified banks. During the period 1950 to 1980, deposit insurance coverage increased substantially. White (1998) argues that small banks supported each of the increases, while large banks opposed them. From the 1980s onwards deposit insurance coverage has not increased but inflation has reduced its real value by approximately 50 percent. Demirguc-Kunt and Kane (2002) argue that globally, deposit insurance has been expanding; while Laeven (2004) argues that coverage levels are higher in countries characterised by weaker and riskier banking systems.

Commercial bank failures as a percentage of healthy banks for the period 1934-39 averaged 0.38% annually. Between 1940 and 1981 this percentage did not rise above 0.08%, then in 1981 it increased dramatically to 0.29% and continued to steadily rise to reach its maximum value of 1.68% in 1988. In an attempt to reduce demands on its insurance funds, the FDIC began the process of merging problem banks with healthy banks.

The wave of bank and thrift failures that occurred during the 1980s and early 1990s halted the increasing coverage of deposit insurance in the US. During this period even the Federal Savings and Loan Insurance Association (FSLIC), the federal insurer

of thrift deposits, failed. The FSLIC was replaced by the Savings Association Insurance Fund (SAIF) alongside the FDIC which supervised deposit insurance for thrifts, with the passage of The Financial Institutions Reform, Recovery and Enforcement Act (FIRREA) in 1989.

In 1991 the FDIC Improvement Act (FDICIA) was passed, which introduced risk-based premiums in an attempt to reduce the risk-taking incentives inherent in deposit insurance. Banks were required to generate sufficient revenue from deposit insurance premia in order to obtain a target ratio of 1.25 percent of deposits insured by the fund. This Act also instructed the FDIC to resolve failed banks in the least costly way to the deposit insurance fund, motivated by the collapse of large banks such as Continental Illinois and Bank of New England during the 1980s, which resulted in the bail out of all creditors in order to avoid systemic disruptions. In addition to least-cost resolution, the FDICIA also introduced prompt corrective action which required regulators to respond quickly when institutions experience trouble.

In 2002 small banks began issuing fully insured certificates of deposit through Certificates of Deposit Account Registry Service (CDARS). CDARS operates via a network of banks whereby a customer's large deposits are split up and distributed among a number of banks (as accounts below the \$100000 deposit insurance limit) which are each members of the network. This effectively enabled large depositors to circumvent deposit insurance limits.

The Federal Deposit Insurance Reform Act was passed in 2005 (which is part of the Deficit Reduction Act of 2005 (S 1932) that was signed into law on February 8 2006). This Act created a new Deposit Insurance Fund (DIF) that merged the old Bank

Insurance Fund with the Savings Institution Insurance Fund. It also increased deposit insurance for retirement accounts to \$250,000, allowing for the adjustment of deposit insurance limits for inflation as of April 2010, and furthermore, increased the FDIC's flexibility in setting risk-based premiums. There still exist constraints on risk-based premiums however, which require that dividends must be paid to member institutions once the new DIF reserve fund reaches 1.35 percent of total insured deposits, in order that the reserve ratio does not exceed this threshold.

2.3.3. Product-Line and Activity Restrictions.

Product-line and activity restrictions refer to those regulations governing both bank products as well as the activities that banks are permitted to engage in. The first explicit restrictions which prohibited banks from engaging in non-bank financial activities, such as underwriting and insurance, were imposed with the passage of the Banking Act of 1933. The four sections of the Act that separate banking and non-banking activity (16, 20, 21, 32) are collectively known as the Glass-Steagall Act (Mester, 1996). The distinction between banks, insurance and securities firms was further highlighted by the passage of the Bank Holding Company Act of 1956. This distinct separation of activity remained until the mid-1980s, when the Federal Reserve and the Office of the Comptroller of Currency (OCC) began relaxing the restrictions on banks, thereby enabling them to engage in activities such as investment banking and insurance.

While Glass-Steagall and the subsequent Banking Acts of 1956 and 1970 prohibited banks and bank holding company affiliates from underwriting, certain securities were deemed 'eligible' by regulators (including municipal general obligation

bonds, US government bonds, and real estate bonds (Kwan, 1998)). In 1987, the Federal Reserve allowed subsidiaries of three BHCs to underwrite certain securities (such as municipal revenue bonds, commercial paper, and mortgage-related securities) providing the revenue generated did not exceed 5 percent of the subsidiary's gross revenue (Bhargava and Fraser, 1998). The Federal Reserve derived the legal authority for this decision from a clause in Section 20 of the 1933 Banking Act.

In 1989 the Federal Reserve continued the expansion of BHC powers by allowing the 'Section 20 subsidiaries' to underwrite corporate debt and equity securities, again subject to the 5 percent revenue limitation. The revenue limit on Section 20 subsidiaries was incrementally increased by the Federal Reserve, which also subsequently allowed other activities such as those related to government securities, to be placed in these subsidiaries.

As BHCs involvement in non-bank financial operations continued to increase, the Federal Reserve enforced firewalls between banking and non-banking activity within the subsidiary structure of the BHC. The purpose of such firewalls was to prevent both financial and information flows between securities and banking subsidiaries. Furthermore, they were intended to protect banking activity from unforeseen shocks to non-bank activity. In July 1996 the Federal Reserve began easing the restrictions between banking and non-banking activities.

The Financial Modernization Act of 1999 (also known as the Gramm-Leach-Bliley Act) completed the dismantling of Glass-Steagall. Under this Act, Financial Holding Companies (FHCs) were permitted to own affiliates engaged in banking, insurance underwriting and securities activities. The first full-service financial

conglomerate to exist in the US since the 1920s was formed as a result of the merger of Citicorp and Travelers, which preceded the passage of the Act by roughly six months.

Since GLBA, the separation between commercial and investment banking has become less distinct. Furthermore, traditional investment banks have become increasingly involved in commercial lending. As commercial and investment banking activities have become less segregated, this has enabled commercial banks to become more involved in the corporate securities markets. For instance, as Loughran and Ritter (1994) report, throughout the 1980s, there was a dramatic increase in the number of initial public offerings (IPOs). Furthermore, throughout this period, firms increasingly used bond financing. The 1980s also witnessed the growth of original issue high yield debt (so-called junk bond) market. Consequently, firms became less reliant on commercial bank borrowing, as public markets now offered a new source of funds. Thus banks have become increasingly exposed to increased competition from other financial institutions.

Both the Reigle-Neal Act and the Graham-Leach-Bliley Act were instrumental in ratifying deregulation that began in the 1970s and spanned several decades. Both Acts also helped accelerate the adoption of new financial processes and information technologies by US banks.

Sufi (2005) analyses how financial conglomerates have come to dominate the market for debt underwriting. In 1996, the top five debt underwriters were all stand-alone investment banks (Morgan Stanley, Salomon Brothers, Goldman Sachs, Merrill Lynch and First Boston). However, by 2003, four of the top five underwriters were owned by full-service financial conglomerates (Citigroup, JPMorganChase, Bank of

America, Merrill Lynch and Credit Suisse). Furthermore, Sufi also argues that traditional investment banks have expanded their activities to include commercial lending. For example, according to Loan Pricing Corporation, Goldman Sachs ranked seventh and Lehman Brothers ranked ninth in arranging syndicated loans during the first half of 2005.

Kroszner (1998) analyses the similarities between this convergence and that observed in the 1920s. In particular with respect to the pressures on commercial banks to become more involved in the corporate securities markets. The increasing frequency with which firms accessed the public equity and debt markets was one of the most notable developments in the 1920s. Throughout this period there was an increase in the volume of new equity issues, in particular during late 1928 and 1929 whereby a dramatic increase was experienced. This trend was mirrored in the 1980s when the number of initial public offerings (IPOs) increased dramatically. Loughran and Ritter (1994) report that from the 1970s to the 1980s the number of IPOs nearly tripled from an average of 120 per year to an average of 350 per year.

In both the 1920s and the 1980s more firms were beginning to use bond financing. Smaller and lesser known firms were able to access the bond markets and as a result the average rating of corporate bonds declined. That is, the proportion of bonds that were initially rated below investment grade rose steadily during the 1920s, from 12 percent in 1921 to 43 percent by 1929 (Kroszner and Rajan, 1994). The same phenomenon is observed during the 1980s when the original issue high yield debt (junk-bond market) began to grow. The number of bonds initially rated below investment grade increased from 24 in 1981 to 200 by 1986, and the amount issued rose from \$1.2 billion to \$30.9 billion during this period (Asquith et al. 1989).

As public markets were increasingly used as a source of funds for firms, reliance on commercial bank borrowing declined. Over the course of the last few decades banks have also been exposed to greater competition from other financial institutions. Commercial bank share of the total assets of U.S. financial institutions has remained roughly constant at 60 to 65 percent over the period 1880 to 1922. Between 1922 and 1929, commercial banks then experienced a dramatic decrease in share to 54 percent, while investment companies (i.e. mutual funds), securities brokers and dealers, finance companies and insurance companies all experienced an increase in share. Between 1980 and 2004, commercial banks again experienced a dramatic decrease in share (which throughout the period 1960 to 1980 had remained relatively stable between 35 and 38 percent) to 24 percent by 2004.

Recessions marked both the beginning and the end of the 1920s and the 1980s, while both decades also experienced lengthy periods of economic growth in between. Furthermore, both periods also suffered a major stock market crash (October 1929 and October 1987) toward the end of each period, although one marked the start of the Great Depression whereas the other was relatively mild. Both recessions were accompanied by a major wave of depository institution failure and closure. During the Great Depression, the banking problems were system-wide and led to a near collapse of the entire financial system (Friedman and Schwartz, 1963; Calomiris and Mason, 2003). However, during the 1980s and early 1990s, the problems experienced in the thrift and banking industries whilst considerable, did not have the same consequences (Barth 1991, Kroszner and Strahan 1996, and White 1991).

2.3.4. Pricing Restrictions.

Regulations governing pricing policies have restricted both bank deposit and bank loan pricing policies. Federal Reserve's Regulation Q, which imposed ceilings on bank deposit interest rates, provides an example of price restrictions affecting the deposit side. When market interest rates were higher than the imposed ceiling rates, banks faced reduced deposit supply which consequently forced them to decrease lending. During the 1970s, high inflation and loose monetary policy caused market rates to increase far beyond the ceiling rates. Furthermore, high inflation also increased the costs of holding non-interest bearing required reserves at bank members of the Federal Reserve System. As a result, the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) was passed by Congress in 1980 which lowered reserve requirements and ended most deposit rate ceilings. Thus although most states still have usury ceilings in place they are generally not indexed to inflation and in the recent low inflation environment have therefore not been binding on traditional bank lending. For 'sub-prime' borrowers who are generally riskier, the ceilings may still bind in various circumstances. Flannery and Samolyk (2005) show that payday lenders, which provide small-value short-term loans (typically less than \$300 for approximately two weeks), typically charge annualised interest rates that are at the state level maximum.

Usury laws restricting the rates that banks are permitted to charge on loans date back to the Colonial period in the US. Standard interpretation of lending-side regulations is that they exist to protect politically powerful borrowers. For example, Benmelech and Moskowitz (2010) report that tighter usury restrictions were found in those states with more powerful incumbent elites. Furthermore, these states were less likely to respond to external pressure for repeal. In contrast to this view, Glaeser and

Scheinkmann (1998) argue that such restrictions exist to reduce the impact of incomplete credit markets. In this model agents borrow to smooth consumption during negative income shocks, and usury laws transfer wealth to low-income states, which encourages a move toward optimal risk sharing.

In 1978 the Supreme Court ruled that Section 85 of the National Banking Act allowed a lender to charge up to the maximum amount allowed in its home state, irrespective of the location of the borrower. This encouraged states to raise their usury limits to compete for those banks providing credit card lending services, as this lending is not geographically based. The result was a rapid increase in the supply of credit card loans which was predominantly concentrated among high-risk borrowers (as credit restriction resulting from interest rate ceilings mostly targets this segment of the market), accompanied by a long and steady increase in personal bankruptcy rates.

2.3.5. Regulation of Bank Capital.

Such restrictions, imposed in order to ensure sufficient capital in the banking industry, date back to the 19th Century when a minimum absolute amount of capital was typically required in order to obtain a bank charter. However, restrictions governing bank capital-asset ratios did not emerge until the 1980s, and came about in response to historically low capital ratios within the banking industry. Leverage ratios have gradually increased over a period starting in the 19th Century until the early 1980s as a result of the introduction of deposit insurance (during the Great Depression), the

increase in bank size and diversification, in addition to better risk management practices that have evolved over time (Peltzman 1970, Calomiris and Wilson 1996).

Regulations governing minimum capital-asset ratios have become increasingly complex in response to the changing nature of banking, whereby a larger proportion of bank business is associated with off-balance sheet activity, thereby generating revenues from non-interest sources. Off-balance sheet activities also represent an important component of bank risk that is not measured by total assets or loans. The initial minimum requirements imposed on banks were based on the raw ratio of equity capital to total assets. However, as bank business has become increasingly associated with off-balance sheet activities such as credit guarantees and unfunded loan commitments, existing regulations were no longer deemed adequate (Boyd and Gertler, 1994). Mishkin and Strahan (1999) note that these off-balance sheet activities have provided a dramatic increase in bank revenues from non-interest sources as well as representing an important component of bank risk that is not measured by total assets or loans. The 1988 Basel Capital Accord included off balance sheet exposures as well as accounting for credit risk in constructing risk-based assets.

Over the last decade banks have employed increasingly sophisticated risk management models, and these new financial technologies have fuelled changes to capital requirements. For example, in 1996 new capital requirements for market risks were adopted using banks' internal risk measurement models. Value-at-Risk models, which estimate quantiles of profit and loss distributions for bank trading positions were the key innovation leading to changes in regulations regarding capital requirements. The strength of these models is that they are able to quantify the likely magnitude of bank

losses during normal market conditions. Sophisticated versions of these models are further able to avoid making strong distributional assumptions (Jorion, 2000).

Basel II was introduced following the successful introduction of market risk capital requirements. The three “pillars” of this Accord are a focus on trying to update capital requirements, ensure effective regulatory supervision and enhance the role of market discipline.

2.4. Technological Changes and Financial Innovation.

During the 1970s and 1980s, a large number of financial and technological innovations occurred. Together with extensive deregulation over the final quarter of the last century, these factors were responsible for eroding the deposit-based funding advantages of US commercial banks. Distribution networks were transformed as a result of innovation, i.e. with the advent of internet banking, in addition banks’ reliance on traditional interest income also declined.

The money market mutual fund (MMMF) introduced in 1971, was the first of such innovations. MMMFs made investments more accessible to the average household as they transformed large-denomination money market instruments (commercial paper, negotiable CDs and Treasury securities) into smaller denomination investments. They allowed investors limited cheque-writing privileges and were also not subject to Regulation Q. In the late 1970s tight monetary policy forced money market interest rates as much as 10 percentage points above the Regulation Q ceiling on deposit interest rates resulting in the dramatic growth of MMMFs during this period as they were not constrained by Regulation Q. This created the process of “disintermediation” whereby

household funds flowed out of bank deposit accounts and into MMMFs. In 1982 The Garn-St. Germain Depository Institutions Act granted banks and thrifts the authority to offer money market deposit accounts (MMDAs), which are transaction accounts with no interest rate ceiling, thereby enabling them to compete directly with MMMFs. The Act also permitted thrift institutions to make commercial loans thereby encouraging more direct competition with community banks.

Another major innovation to influence retail banking during the 1970s was the automated teller machine (ATM). The introduction of the ATM improved service quality by providing greater convenience for retail customers. Bank revenues were also enhanced by charging transactions fees to customers of other banks; furthermore, bank branch efficiency was improved as ATMs replaced more expensive human tellers. DeYoung, Hunter and Udell (2004) report that the average banking office in the US has become more productive since the 1980s, as indicated by an increase in assets, operating income, and the number of transactions per banking office. The authors argue that this helps to explain the large increase in the number of bank branches since the 1970s.

In contrast to most developed countries, by the end of the 20th Century, approximately two-thirds of US payments transactions were still conducted using cheques and cash. However, electronic payments technologies are rapidly replacing paper-based payments. Evidence to support this is provided by Gerdes and Walton (2002) and Humphrey (2002). Both studies report an annual decline in the number of cheques paid in the US by approximately 3% during the late 1990s. While Gerdes and Walton report an annual increase of 7.3 percent in payments made by credit cards, Humphrey reports this increase to be 35.6 percent per year. Similarly, Berger (2003)

analyses the volume of automated clearinghouse (ACH) transactions handled by the Federal Reserve for the period 1990 to 2000. Berger reports that both automatic payment of recurring monthly bills and automatic deposit of wage and salary payment transactions increased at a rate of 14.2 percent annually throughout the period. The Federal Reserve Survey of Consumer Finance 2004 indicates that US consumers now hold smaller precautionary balances. For instance, between 1983 and 2001, the fraction of household financial assets held in transactions accounts decreased from 7.3 percent to 4.6 percent. This decline can be attributed to the fact that electronic payments are more predictable than cheque-based payments in terms of dispersal and receipt dates.

Internet banking is yet another innovation to transform banking in the US. Its advent has further diminished the importance of geography, and reduced the cost of producing basic banking services. This is supported by a number of authors including DeYoung (2005), DeYoung, Lang, and Nolle (2007) who report that small banks may enhance their profitability by offering internet banking services. Currently there are only a few US banks that offer services exclusively via the internet. The predominant internet banking strategy is the “click-and-mortar” model whereby banks combine a transactional internet site with networks of traditional brick-and-mortar offices and ATMs.

Securitized lending is another financial innovation that has had a massive effect on the structure and performance of the US banking industry. A loan securitization refers to a trust that purchases existing home mortgage loans (or auto loans, or credit card receivables) from banks using funds raised by selling “mortgage-backed securities” (MBSs) to third-party investors. The return on the MBSs is dependent on the performance of the mortgage loans held in the trust. This process therefore enables

banks to sell their otherwise illiquid loans to the securitization and use the revenue they receive from doing so to fund additional loans or alternative investments. Berlin (2007) reports a growing secondary market for syndicated loans. These are loans made to large firms by syndicates of large banks, thus providing similar liquidity benefits to securitized loans and reducing the cost of loans to large firms. The introduction of MBSs has enabled community banks to better diversify their loan portfolios by purchasing MBSs from securitizations of mortgages from other areas of the country. Many large retail banks have also transformed themselves from traditional originate-and-hold mortgage lenders to originate-and-securitize mortgage bankers. As a result, large retail banks are now less reliant on traditional interest-based income while non-interest income from loan origination fees, loan securitization fees, and loan servicing fees has increased.

The growth in securitized mortgage lending was boosted by the introduction of two government-sponsored enterprises (GSEs), namely the Federal National Mortgage Association (Fannie Mae, founded in 1938) and the Federal Home Loan Mortgage Corporation (Freddie Mae, founded in 1970). Approximately half of total residential mortgage debt in the US are either securitized by, or held in the portfolio of, these two GSEs. Prior to the 2007 financial crisis, both enterprises had large lines of credit at the US Department of the Treasury, and were perceived to be “too-big-to-fail”. This effectively gave them a funding advantage over private sector mortgage securitizers.

Another financial innovation fundamental to loan securitization is credit scoring. First introduced in the 1950s, credit scoring refers to the process whereby quantitative information concerning individual borrowing such as income, employment or payment history is transformed into a single numerical credit score. Mester (1997) reports the

now widespread use of credit scoring in consumer, mortgage and micro-small business lending. Credit scores are widely used; for instance lenders apply them when analyzing loan applications, investment banks use them to construct pools of loans to be securitized and bond-rating companies use credit scores to assign risk ratings to asset-backed securities. While most lenders rely on third-party credit bureau scores for screening purposes, some banks (mostly larger ones) have developed their own credit-scoring formulas. Credit-scoring has significantly reduced the unit cost of underwriting individual loans thereby increasing the minimum efficient scale of consumer loan underwriting which financial institutions undertake. Various authors including Berger, Frame and Miller (2005); and Frame, Srinivasan and Woosley (2001) have argued that the introduction of credit-scoring has provided greater incentive for lenders' to offer additional credit.

2.5. Structure of the U.S. Banking Industry.

As mentioned above, the US banking industry was subject to extensive regulations for many decades, which consequently stifled the growth of existing banks. Thus, relative to the largest European and Japanese banks, the biggest US banks have typically been smaller. Deregulation has drastically altered the structure of the US banking industry as commercial banks have grown rapidly, predominantly via mergers and acquisitions of other US banks. Tables 2.1 and 2.2 present summary information regarding the number of commercial banks since the mid-1980s, including the number of bank additions and

deletions. More specifically, Table 2.1 shows the number of banks and branches by year over the period 1984 to 2009. At the start of the sample period there were more than 14000 commercial banks and over 42000 branches. By 2009 the number of banks had fallen to less than 7000, while the number of branches had roughly doubled. Figure 2.2 graphically represents the information regarding the number of banks. Table 2.2 shows the changes to the number of commercial banks in terms of additions and deletions to the number of bank charters. For instance, on average, approximately 350 commercial banks were acquired each year during the 1980s, approximately 500 each year during the 1990s, and approximately 300 each year during the first half of the 2000s. Furthermore, since the 1980s, more than 10 000 bank charters have been merged out of existence. For comparison, from the 1950s to the 1980s, the number of commercial banks remained stable at roughly 14000 banks; following deregulation however, the number of commercial bank charters fell to less than 7000 by 2009.

Additionally, a wave of bank failures has also contributed to the fall in US commercial bank charters. During the late 1980s and early 1990s, more than 1500 insolvent banks were dissolved by regulators, primarily as a result of both an unexpected increase in interest rates and sustained regional declines in real estate values.

While the number of US commercial banks diminished as a result of mergers and failures, more than 7000 new banking charters have also been granted since 1970. When small banks are acquired by large out-of-state banks, this inevitably causes a degree of dissatisfaction among both employees and customers, thus prompting them to change banks, or even establish new banks (a relatively straight-forward task in the US, given the small amount of investment capital required to start up a new bank).

Table 2.1. Number of Institutions and Branches.

Year	Institutions	Branches
2009	6823	82437
2008	7072	82287
2007	7266	78462
2006	7384	75913
2005	7510	72869
2004	7615	70264
2003	7753	67631
2002	7871	66317
2001	8064	65046
2000	8297	64284
1999	8564	63726
1998	8759	62066
1997	9125	60392
1996	9510	57823
1995	9922	56363
1994	10432	54585
1993	10945	52540
1992	11450	51643
1991	11909	51968
1990	12329	50479
1989	12697	48088

1988	13119	46468
1987	13705	45488
1986	14193	44528
1985	14402	43442
1984	14483	42390

Notes: Entries are the number of commercial banks and their branches over the period 1984 to 2009. Source: FDIC Commercial Bank Reports, Table CB01.

In particular, the majority of the decline in bank numbers occurred in the community bank sector, i.e. banks with less than \$1 billion in assets and especially within the smallest size group of banks. This decline does not appear to have been confined to a particular region or market though, but was rather relatively uniform. Again, most of this decline was attributable to mergers and acquisitions; although, bank failures also accounted for a significant proportion of the decline. While small banks have experienced a large fall in numbers, these community banks still account for the largest share of banking organisations. Alongside the decreasing numbers of small banks within the US banking sector, there has also been an increase in the number of large banks. Following deregulation and the removal of barriers to competition, the largest banks have grown even bigger, with industry assets becoming increasingly more concentrated among these banks.

Table 2.2. Number of Bank Additions and Deletions by Type.

Year	Additions			Deletions			Year End Total
	New Charters	Conversions	Unassisted Mergers	Mergers	Failures Paid Off	Other	
2009	24	10	158	114	6	13	6826
2008	90	19	259	19	0	25	7083
2007	175	19	293	1	0	14	7277
2006	177	12	309	0	0	1	7391
2005	167	11	271	0	0	17	7512
2004	120	25	262	3	0	20	7622
2003	110	18	225	2	0	13	7762
2002	90	13	275	6	4	25	7874
2001	125	16	359	3	0	-2	8081
2000	188	22	456	6	0	17	8300
1999	227	18	418	7	0	37	8569
1998	187	28	559	3	0	4	8786
1997	182	51	599	1	0	16	9137
1996	139	35	553	5	0	22	9520
1995	96	28	608	6	0	39	9926
1994	45	12	547	12	0	-2	10455
1993	47	12	480	56	5	31	10955
1992	40	10	429	86	11	4	11468
1991	76	31	446	101	4	-58	11948
1990	138	20	392	151	8	-23	12334
1989	170	8	413	196	9	-19	12704
1988	191	3	600	201	6	8	13125
1987	196	36	541	176	11	-29	13746
1986	215	31	346	120	21	-41	14213

1985	279	43	334	93	22	-45	14413
1984	356	8	331	73	4	0	14495

Notes: Entries are the number of commercial bank additions and subtraction by type over the period 1984 to 2009. Source: FDIC Commercial Bank Reports, Table CB02.

Following deregulation, the largest US banks have rapidly increased in size. During the mid-1980s only the largest US commercial banking company (Citibank) had more than \$100 billion in assets, but by the mid-2000s nearly twenty US banking companies had more than \$100 billion, and three exceeded \$1 trillion. Indeed the lower part of Figure 2.2 shows the proportion of all bank assets held by the top 5%. As can be seen this has increased from the low 70% in the mid-1980s to the high 80% at the end of the sample. As mentioned above, bank mergers have contributed greatly to this growth, which while having little effect on the structure of local banking markets, has influenced the nature of competition in these markets. For instance, DeYoung, Hasan and Kirchhoff (1998) and Evanoff and Ors (2002) report that following the acquisition of a local bank by a large out-of-market bank, the cost efficiency of other local banks tends to improve, presumably as a result of increased competitive pressure.

Following deregulation, US banks have expanded not only within domestic markets, but now compete in foreign, global markets also. Through rapid geographic growth and expansion into investment banking services, US commercial banking companies now rank among the world's largest in terms of syndicated lending, debt underwriting, and equities underwriting.

Consolidation and geographic expansion has also altered the nature of bank delivery systems. For example, since 1980 the number of commercial banks has halved, yet the number of bank branches has nearly doubled. By increasing the number

of branches it owns, a bank is able to establish a greater market presence and limit entry by competitors.

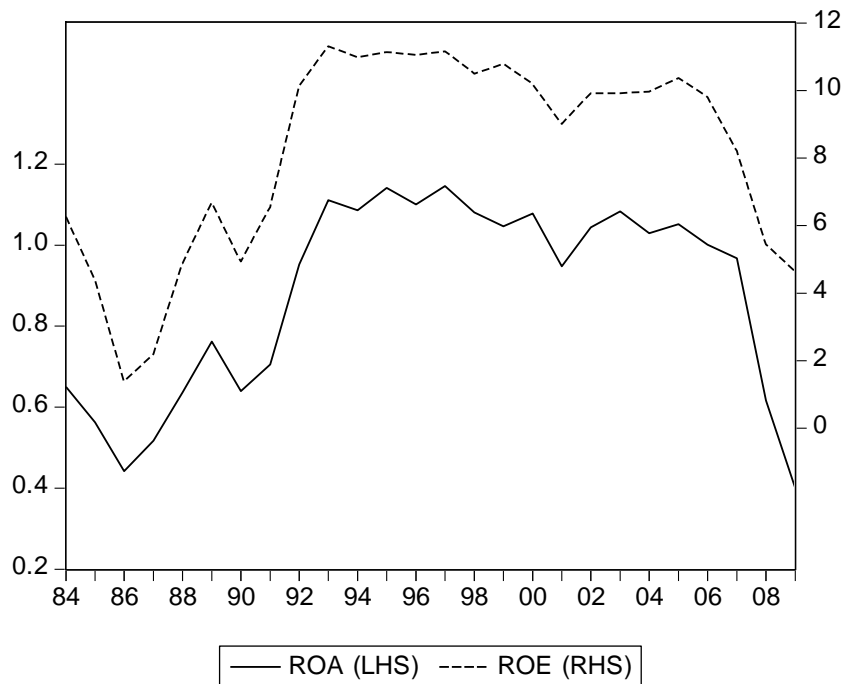
Consolidation during the 1980s and 1990s has been accompanied by an increase in the portion of industry income generated from fees rather than interest, as larger banks generate a greater portion of their income from non-interest activities than smaller banks. DeYoung and Roland (2001) have argued that the increase in non-interest income at US banks has fundamentally altered their risk-return profiles. Several other empirical studies have investigated the riskiness of non-interest income. DeYoung and Rice (2004a) found that marginal increases in non-interest income are associated with a worsening of banks' risk-return trade-off. Stiroh (2004a, 2004b) found no evidence of diversification gains at banks that combine interest and non-interest income. Clark, Dick, Hirtle, Stiroh, and Williams (2007) emphasize how the increasingly retail-focused strategies of large US banking companies expose these banks to economic and business cycle volatility.

The sub-prime mortgage crisis which began in 2007 demonstrates the income volatility associated with fee-driven transactions banking. Investors in sub-prime mortgage-backed securities suffered large capital losses as borrowers defaulted. In addition they suffered huge losses in fee income from originating and securitizing the underlying sub-prime mortgage loans. Diversified financial institutions that invested heavily in sub-prime mortgage-backed securities (e.g. Merrill Lynch, CitiGroup) suffered large but ultimately sustainable losses - even though CitiGroup and other US financial institutions required large infusions of capital from foreign investors. However, mortgage banking companies with non-diversified strategies were not able to

survive the crisis, due to dramatic reductions in non-interest income from their mortgage origination and securitization activities.

Finally, Figure 2.1 shows how these changes have impacted average profitability of the banking sector from the mid-1980s. What can be seen from this figure is that profitability increased from the early 1980s. This may in part be linked to macroeconomic events such as the emergence from the recession of the early 1980s and the resulting economic expansion, which in turn was aided by low international commodity prices. This period also saw the emergence of inter-state banking which may have increased competitive pressures, hence leading to an increase in the profitability of the sector. A small downturn in profitability is noticed in the early 2000s, again this may be associated with the mild economic recession that resulted from the dotcom crash. While there is no obvious change in profitability following the 1999 GLBA. Finally, there is a downturn in profitability associated with the onset of the financial crisis.

Figure 2.1. Mean Profitability 1984-2009



2.6. 2007 Financial Crisis (Subprime Mortgage Market Crisis).

In the summer of 2007 the subprime loan market began to experience significant problems as several lenders filed for bankruptcy. The resultant huge losses incurred were not confined to those firms operating in the subprime mortgage market, but were rather far-reaching throughout the financial sector, with many other firms suffering credit and liquidity problems. In June 2007 Bear Stearns bailed out two of its hedge funds, costing the company \$3.2 billion. At the start of August 2007 a leading home loan provider, American Home mortgage, filed for bankruptcy. This was followed a few days later by BNP Paribas' suspension of three of its hedge funds worth €2 billion. By the end of June, Countrywide, the leading subprime lender, raised \$2billion in

capital from the Bank of America in order to improve its financial condition, and was subsequently acquired by the Bank of America.

In March 2008, the Fed funded a loan to JPMorgan Chase which enabled them to acquire Bear Stearns when it collapsed. In contrast however, the Fed did not provide any financial assistance to Lehman Brothers a few months later, and subsequently the firm was forced to file for bankruptcy in September 2008. The Fed did assist insurance giant American International Group (AIG), extending an \$85 billion loan in exchange for a 79% ownership stake. AIG received further loans and capital injections from the Fed and the Treasury in order to prevent its collapse.

In 2008, the government also took action to assist the mortgage market. The Housing and Economic Recovery Act, passed in July 2008, authorised the Federal Housing Authority to guarantee up to \$300 billion in new thirty-year fixed-rate mortgages for subprime borrowers. By September 7 2008, the Government-Sponsored-Enterprises (GSEs) Fannie Mae and Freddie Mac were effectively nationalised, in order to ensure they remained solvent, as a result of their deteriorating financial situation.

Despite the interventionary government policy the financial climate continued to deteriorate, and in October 2008, the Emergency Economic Stabilization Act was passed. This Act authorised the Treasury to use up to \$700 billion to stabilise the financial sector as well as increasing the limits on bank deposits insured by the FDIC. TARP (Troubled Asset Relief Program) is part of the Emergency Economic Stabilisation Act signed into law on October 3 2008. The initial proposal was to allow the US Treasury to purchase or insure up to \$700 billion of troubled assets from a wide range of financial instruments including mortgage-backed securities held by US

financial institutions. The aim of this program was to promote stability and strengthen the US financial sector. Subsequently the Dodd-Frank Wall Street Reform and Consumer Protection Act reduced the amount authorised to \$475 billion and by March 12 2012, the Congressional Budget Office (CBO) further reduced this amount to \$431 billion.

During the period 28th October 2008 to 14 August 2009, \$204 billion had been injected by the Treasury into 668 financial institutions. Furthermore, over this period 36 institutions had repaid \$70 billion back to the Treasury. FDIC unlimited insurance coverage was also extended to all noninterest-bearing transaction accounts. The Fed also sought to lower home mortgage rates by agreeing to purchase housing-related securities issued and guaranteed by Fannie Mae, Freddie Mac, Ginnie Mae and Federal Home Loan Banks in addition to lending money against securities backed by car loans, student loans, credit-card debt and small-business loans. Furthermore, from 18 September 2007, the Fed lowered its target federal funds rate ten times from 5.25% to 0-0.25% on 26 September 2008.

In response to the financial crisis of the late-2000s, the Dodd-Frank Wall Street Reform and Consumer Protection Act was passed on 21 July 2010. This Act is the most drastic change to financial regulation in the US, since the Great Depression. It extends to all Federal financial regulatory agencies, and affects most aspects of the US financial services industry. The major components of the Act include the consolidation of regulatory agencies to improve accountability and transparency in the financial system; protection of the American taxpayer by ending bailouts (thus eliminating the “too big to fail” attitude) and the protection of consumers from abusive financial services practices.

As discussed in Aubuchon and Wheelock (2010), the financial crisis that began in 2007 resulted in a large increase in the number of bank failures. Between 1st January 2007 and 31st March 2010, 2.4% of all federally insured banks (206 commercial and savings institutions) in operation on 31st December 2006 failed. These failed banks held 6.5% of total US bank deposits (\$373 billion) as of 30th June 2006. This is in stark contrast to the decade preceding the 2007 financial crisis, whereby, on average only 4 banks a year failed; but more similar to the period of bank failures that occurred during the 1980s and early 1990s when, for example, more than 100 bank failures occurred each year from 1987 to 1992. See Figure 3. Throughout the 2007-10 financial crisis states that experienced more severe economic distress were typically also characterised by higher bank failure rates. This regional pattern of bank failures suggests that banks still remain vulnerable to local economic shocks, in spite of deregulation intended to remove branching restrictions.

Wheelock (2010) also compares the Federal Reserve's responses to the crises of 1929-1933 and 2007-2009, in order to determine whether lessons were learned and thus whether the impact of the more recent crisis was in any way curbed by the Fed. The author reports that the economic recession brought about by the 2007-2009 crisis was mild in comparison to the Great Depression and is widely believed to be the result of aggressive interventionary policies.

Deregulation and the creation of branch networks facilitated both geographic diversification and scale economies for banks, thus theoretically rendering them less vulnerable to local economic shocks. While the 2007 financial crisis affected most areas of the U.S. the extent to which house prices and personal incomes declined varied considerably across both state and local markets. Therefore, by operating branches in

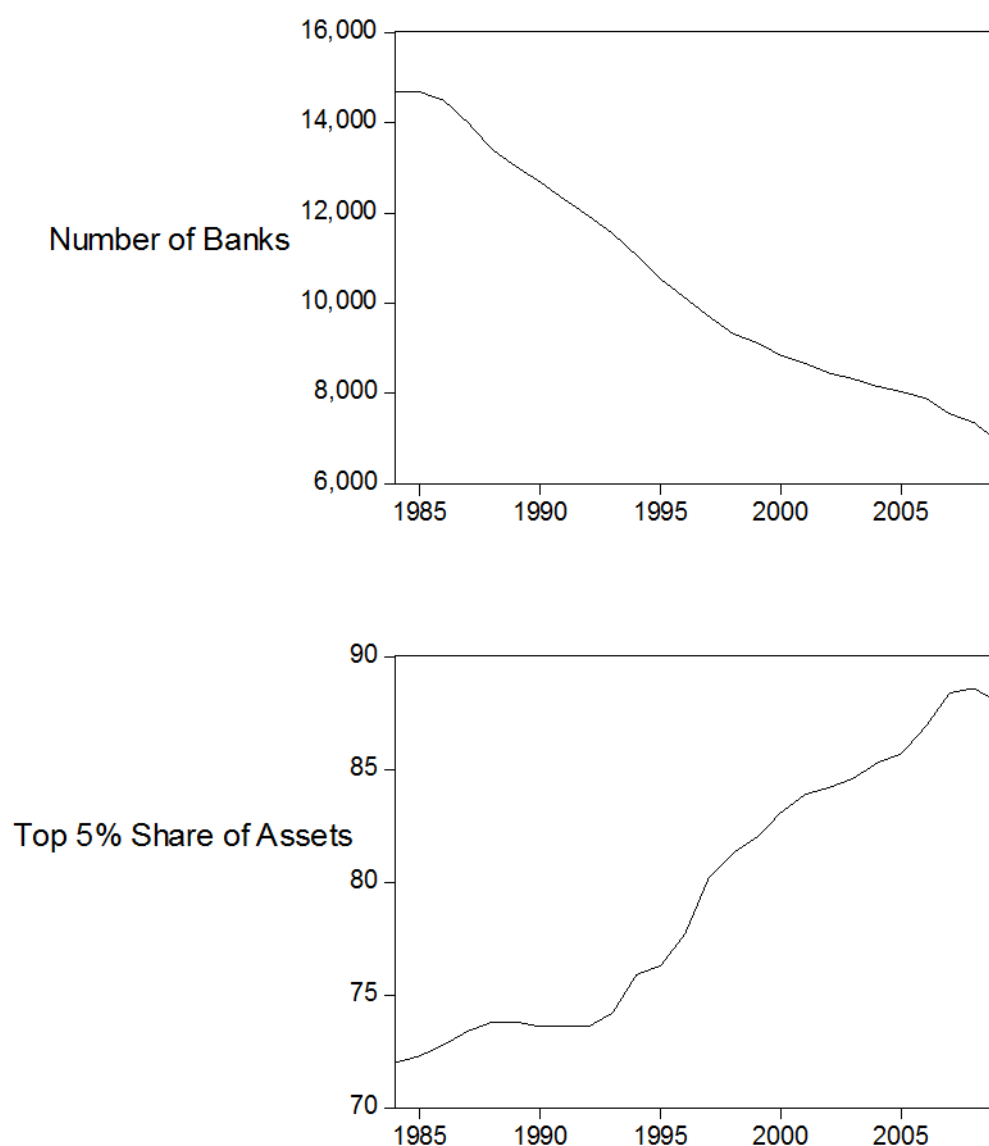
different markets, some banks may have been able to protect themselves somewhat against downturns in local real estate markets and economic activity. Some banks with extensive branching networks still suffered significant losses however, as a result of a lack of diversification across markets (both product and geographic), and heavy investment in nonprime mortgages and mortgage-backed securities (for example, Washington Mutual). Wheelock (2010a) finds that throughout the period January 1 2007 until March 31 2010, the state of Georgia had the highest number of bank failures (36 out of 346 banks); while Nevada experienced the highest failure rate (ratio of failed to total banks), with 5 out of 28 banks failing. Fifteen states had no bank failure over the same period, with six of these states in the Northeast.

The financial crisis starting in 2007 came about as a result of a decline in house prices and significant increase in mortgage delinquency rates. Savings institutions, which historically have focused on residential mortgage lending, were especially vulnerable to the decline in house prices. Following deregulation, in more recent years both competitive pressures and potential profit opportunities have led to an increase in real estate lending by commercial banks.

A strong negative correlation exists between state bank failure rates throughout the 2007-2010 crisis and growth of per capita personal income and gross state product. Furthermore, states with the largest decline in personal income or gross state product also tended to have the highest bank failure rates and the largest increases in unemployment rates. Bank failure rates were typically higher in states experiencing the biggest drop in house prices and the greatest rise in home mortgage delinquency rates. Prior to 2007, these states had also experienced the largest increases in both subprime mortgages as well as house prices.

The 2007 financial crisis and recession produced a marked increase in the number of bank failures which, along with a wave of mergers, resulted in a large decline in the number of banks. In total, between December 31st 2006 and December 31st 2010, the number of US banks fell by 12 percent, continuing a trend of consolidation that started in the mid-1980s. In addition, total US deposits held by the 10 largest commercial banks increased from 44 to 49 percent over the same period (Wheelock 2011a). Wheelock also reports that the average concentration of local banking markets changes very little over time, as too does the average number of dominant banks in them, even during the recent financial crisis and recession when numerous bank failures and several large mergers occurred. That is, in markets where local offices already existed for both the acquiring and acquired banks, on average there was no significant increase in concentration, in particular, given that most banks that failed during the recent crisis were small. However, such mergers typically resulted in larger increases in concentration in rural markets, compared to urban markets (Wheelock 2011b). The author also reports that throughout this period unassisted mergers potentially had a greater influence on the structure of the banking industry, as they accounted for more of the decline in the number of US banks than bank failures did. Furthermore, the author also argues that the relevance of local market characteristics in analysing competition in banking may become less important as technology continues to evolve, thereby lowering the costs of obtaining banking services from other geographical areas.

Figure 2.2. Number of Banks and Share of Assets



2.7. Summary and Conclusion.

The purpose of this chapter is to provide an overview of the structure and performance of the US banking system. The chapter begins by providing a brief historical background of the evolution of the US banking system, from the origins of the First Bank of the United States in 1791 to a peak of approximately 14000 banks in the 1980s

and falling to just below 7000 currently. The creation of the unique dual banking system, the FDIC and Federal Reserve System are also discussed.

The chapter then discusses the evolution of the key regulatory changes that have impacted upon the US banking system. Extensive interventionary government policy aimed at protecting the banking sector by reducing competition was first introduced in response to the Great Depression during the 1930s. This highly restrictive legislation remained in place until the 1980s, when the process of deregulation began. The five key areas that regulatory policy focused on are discussed, namely, restrictions on entry and geographic expansion; deposit insurance; product-line and activity restrictions; pricing restrictions and capital regulation.

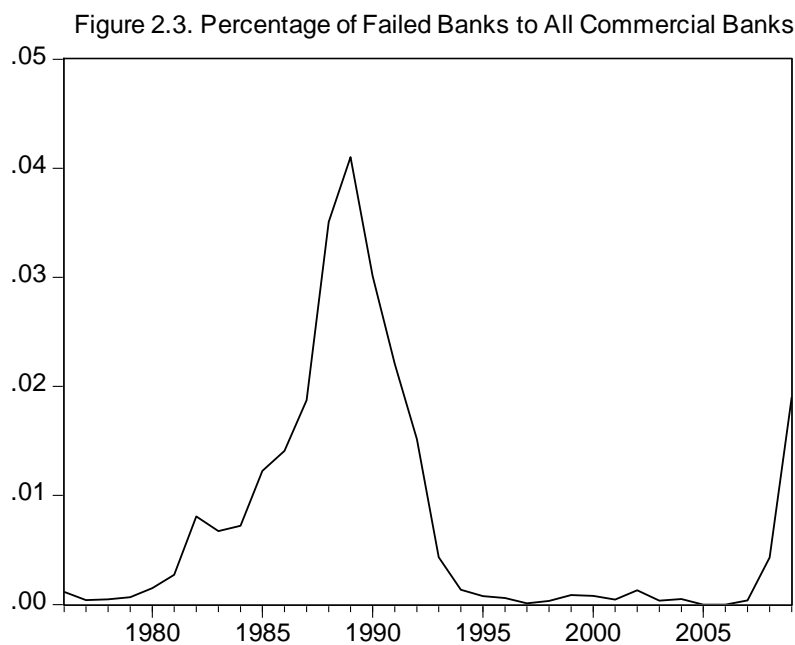
The impact of technological and financial innovation on the banking sector is then reviewed. During the 1970s and 1980s a large number of new financial tools, such as MMMFs and securitised lending were created, in addition to technological advances, such as the creation of the ATM. Combined with the effects of deregulation, these innovations completely transformed the banking industry. As banks expanded their products and services into these new areas, the proportion of their income generated from traditional fee-based activities declined while at the same time non-interest income from these new areas of business began to rise. Advances in technology also had a significant impact on banks operations and delivery networks. For example not only were banks able to expand their operations geographically with the advent of internet banking, but also innovations such as the ATM enabled banks to operate more efficiently as they replaced more costly and inefficient people.

We then consider an overview of the structure of the commercial banking industry, and how it has evolved in response to deregulation. The extensive regulatory policy imposed during the 1930s in an attempt to restore stability was aimed at protecting incumbent banks by restricting competition. Consequently the growth of banks was also restricted, and therefore prior to deregulation, the largest banks in the US were much smaller than the largest European and Japanese banks. Mostly via mergers and acquisitions, the largest US banks dramatically increased in size following deregulation throughout the 1980s and 1990s, and now compete on a global scale. The number of banks has also changed drastically over this time period in response to the changing environment. In the early 1980s there were roughly 14000 banks, by 2009 the number had more than halved to less than 7000 banks. At the same time, the number of bank branches has roughly doubled from approximately 42000 branches in 1984 to just over 82000 branches in 2009. During the late 1980s and early 1990s there were also more than 1500 bank insolvencies, mostly via mergers and acquisitions of failing banks. The US banking industry has also experienced a large volume of new bank charters, totalling more than 7000 since the 1970s.

With the removal of restrictive regulatory policies, banks have become more diversified in the products and services they offer. As a result, the industry has experienced a decrease in the proportion of revenue generated from traditional interest-based income while fee-based income has increased. This is mostly driven by larger banks, as they generate a greater proportion of their revenue from non-interest income than smaller banks.

Finally, this chapter examines how the 2007 financial crisis impacted on the US banking industry. In the summer of 2007, the sub-prime mortgage market began to

experience problems which had far reaching consequences throughout the entire financial sector. A number of large financial institutions collapsed, were forced to file for bankruptcy, or received government aid. Furthermore, the government sponsored enterprises Fannie Mae and Freddie Mac were effectively nationalised in order to ensure they remained solvent. An extraordinary amount of government aid was injected into the financial sector in an attempt to restore stability and public confidence. In addition, new legislation such as the Dodd-Frank Wall Street Reform and Consumer Protection Act was passed, which aims to consolidate regulatory agencies in order to improve accountability and transparency in the financial system. In addition, the Act seeks to ensure the protection of the American taxpayer by ending bailouts, thus eliminating the “too big to fail” attitude, and the protection of consumers from abusive financial services practices.



Source: FDIC

Chapter 3. Competition in Banking.

3.1. Introduction.

Competition in banking encourages efficiency in the production and allocation of financial services. In banking, the level of competition has implications for entrepreneurship, access to finance, the allocation of capital funds, the competitiveness and development of manufacturing and service sectors, the level of economic growth and the extent of financial stability. Competition can make markets work more efficiently by encouraging innovation, lower prices and higher quality products to enhance consumer choice and welfare.

Moreover, competition is believed to be a good thing because a competitive banking system is more efficient and therefore important for economic growth. For consumers competition is good because it keeps bank tariffs low and service levels high, while it also forces banks to become more efficient and stable. Interest rates on loans are lower, while higher interest rates are paid on deposits. Thus, competition maximizes welfare by ensuring that the greatest quantity of credit is supplied at the lowest price. More recently however, research has sought to examine whether competition may lead to banking system instability. That is, while competition is believed to be beneficial as mentioned above, conversely too much competition may lead banks to engage in excessively risky behaviour in order to make a profit.

Over the last decade or so, banking markets have experienced a number of dramatic changes. Historically, regulation in the banking industry was protective, and often had the effect of inhibiting competition and growth. However, over the last few decades structural changes (for instance the creation of a single European financial

services market, and deregulation in the US which opened up competition by enabling banks to operate across state lines) and conduct deregulation, has consequently led to a change in the competitive environment within which banks operate. Examining the changing nature of competition in banking and its impact on bank strategy and performance is thus of importance as the results have implications for future competition, regulatory and supervisory policy.

There exists a large literature examining the microeconomics of competition in banking and is presented here in three sections; namely SCP in Banking, New Empirical Industrial Organisation and Other Approaches. Those studies which adopt the Structure Conduct Performance (SCP) approach, seek to determine the extent of competition within a given market structure based on the assumption that there exists a link between market structure and the conduct and performance of firms and industries. Under this approach it is argued that greater industry concentration, resulting in increased individual market power of large banks, is more likely to lead to anti-competitive behaviour by banks.

SCP studies both in general, and those focused on the banking industry, have been criticised because the measures of market structure typically used may potentially be subject to endogeneity. This problem was particularly pronounced in the majority of the earlier banking studies which attempted to relate measures of bank rates of return to measures of market concentration. The SCP hypothesis was typically tested using a simple measure of concentration (for instance the n-firm concentration ratio, or the Herfindahl-Hirschman Index) as an exogenous indicator of market power. In general, concentration measures were unable to allow for differences in the size or type of commercial banks. Bank prices and measures of profitability were typically specified

as the endogenous indicators of bank conduct and performance respectively. Furthermore, the models employed were usually static cross-section comparisons or short-run in nature and typically focused on local U.S. banking markets.

In response to the recognised shortcomings of the SCP approach (such as its reliance on accounting data and endogeneity issues pervading the relationship between variables of interest), the Chicago/ Revisionist critique was developed in the 1970s. At the centre of this critique is the efficiency hypothesis (Demsetz, 1973) which stipulates that greater profitability and increased concentration exists in response to more efficient firms dominating a market, leading to greater profitability and increased concentration; rather than as a result of a causal relationship between market concentration and efficiency. Therefore, high concentration and subsequent high prices or profits is a reflection of more efficient performance by banks, rather than an indication of more effective collusion within the markets. As such, a highly efficient bank may earn greater profits as a result of its ability to better maximise returns.

In response to shortcomings of the SCP and Efficiency Hypothesis paradigms, the New Empirical Industrial Organisation (NEIO) approach was developed. With a focus on bank level rather than industry level conduct/strategy, NEIO studies seek to examine the response of prices (and in some instances quantities) to changes in competitive conditions. Thus, the extent of competition or collusion within a market can be inferred by examining the behaviour of incumbent banks. The two main empirical techniques used to test bank conduct directly are the Panzar-Rosse (PR) and Bresnahan-Lau (BL) approaches.

. The remainder of this chapter is structured as follows. Section 2 reviews SCP within banking and the revisionist critique. Section 3 reviews the efficiency in banking literature that developed after the SCP literature. Section 4 reviews the NEIO literature, while Section 5 reviews other approaches. Finally, Section 6 summarises and concludes.

3.2. SCP in Banking and Revisionist Critique.

The Structure Conduct Performance (SCP) paradigm, which has its roots in the field of Industrial Organisation, stipulates that there exists a link between market structure and the conduct and performance of firms and industries, thus allowing us to define the extent of competition prevailing in a given market structure. Bank performance (usually measured by profitability indicators such as bank profit rates, interest rates banks charge on loans, and interest rates they pay on deposits) is determined by the conduct of banks, which in turn is influenced by structural industry-level variables (including concentration, economies of scale, and entry and exit conditions). For instance, under perfectly competitive conditions in which the industry contains a large number of banks and consumers and is therefore not highly concentrated (structural variables), banks are price-takers and therefore adopt pricing strategies based on those adopted by their competitors (conduct variables). In such a market, banks would earn normal profits and interest rates would reflect competitive levels (performance indicators). On the other hand, under the highly concentrated market conditions of monopoly (structural variable), the incumbent bank would be able to determine its own pricing strategy above the level that would occur under competitive conditions (conduct variable) resulting in bank performance variables such as profit rates and interest rates

charged on loans being higher (while interest rates paid on deposits would be comparatively lower). Conduct variables include forms of strategic behaviour adopted by firms, for instance price setting or collusion amongst incumbent firms, as well as expenditure on advertising, R&D and innovation. With its focus upon market structure, the SCP approach argues that industry concentration or individual market power of large banks increases the likelihood of anti-competitive behaviour leading to lower interest rates on deposits, higher interest rates on loans and higher profits of incumbent banks. Allowing a gauge of the extent of competition is important for antitrust policy.

There are a number of significant drawbacks to the SCP hypothesis, for instance, a common finding in the literature was that the simple measures of concentration employed (i.e. HHI and CR_n) had only very weak relationships with measures of profitability when including the market share of the firm in the regression equation. That is, under the traditional SCP approach, the market shares of all banks were generally treated as equal in calculating the concentration measure, and thus this approach was unable to explain why profitability varies between firms. In response, new perspectives on industrial organisation were developed that challenged the usefulness of the structure-performance framework for analysing the determinants of competitive behaviour, as it fails to account for differences in productive efficiency.

During the 1970s the Chicago school, represented by academics including Stigler (1968) and Demsetz (1973, 1974) developed the Chicago/Revisionist critique in response to the shortcoming of the SCP approach. Central to this critique is the efficiency hypothesis which argues that large banks make high profits because they are more efficient. The link between high concentration and high prices or profits is merely an artefact of the efficiency performance relation, rather than necessarily reflecting

more effective collusion in markets that are more concentrated. That is, a highly efficient bank may have higher profits as a result of its ability to better maximise returns. The bank may therefore naturally gain a larger share of the market and/or use its own success to take over banks which are performing less well. Both situations would lead to an increase in concentration in the market. In such circumstances it is possible for concentration to lead to higher bank profits without negatively influencing the credit supply, as predicted by the market power theories.

3.2.1. Structure and Prices.

The SCP line of research dates back to the 1960s, whereby the studies undertaken typically estimated measures of bank performance as functions of the concentration of deposits among banks in the local market areas. Edwards (1964) and Meyer (1967) used U.S. data for Standard Metropolitan Statistical Areas (SMSA) over the time period 1955 to 1957 to examine the relationship between market concentration and the interest rates charged on business loans. Fraser and Rose (1971) use data from the years 1966 and 1967 for 78 Texan cities to examine the relationship between market concentration and the interest rates banks charge on loans, the interest rates paid on time and savings deposits and the service charge revenue on demand deposits. They find that when market interest rates are higher the influence of market concentration appears to be smaller.

Further studies have examined the relationship between market concentration and interest rates paid on time and saving deposits and found that there does not appear to be a significant relationship. Examples of such studies include Fraser and Rose

(1971) who suggest the influence of Regulation Q³ ceiling rates as a possible explanation. This highlights one of the short-comings of the early studies; failure to account for the impact of regulation on bank performance. For instance, bank performance may be affected by the imposition of ceiling rates (for example on time and savings deposits) when market interest rates are high relative to these ceiling rates, irrespective of the level of concentration within the local market. Confirmatory evidence is provided by other authors including Klein and Murphy (1971) and Ware (1972). In contrast, several studies provide evidence that refutes the regulation Q explanation. Examples of these include Rose and Fraser (1976) using data from 1973 for 90 Texan counties and Rhoades (1979) using data for 184 SMSAs from 1970 and 1972.

More recently, Besanko and Thakor (1992) examined loan and deposit markets within the context of a theoretical model where banks can differentiate themselves from competitors. Their results suggest that as competition increases within a market (as more banks enter the market), loan rates decrease and deposit rates increase. Guzman (2000), using a simple general equilibrium model, compares the effect on capital accumulation of an economy with a monopoly banking system versus one with a competitive banking system. The results demonstrate that downwards pressure on capital accumulation is observed under a monopoly banking system. Both of the above mentioned models reinforce the theory that market power is detrimental to consumers and growth, thus lending support to the SCP hypothesis.

³ Regulation Q prohibited banks from paying interest on demand deposits in accordance with Section 11 of the Glass-Steagall Act, from 1933 to 2011. In addition, from 1933 to 1986, it also imposed maximum or ceiling rates of interest on other types of bank deposits such as savings or NOW accounts

Indeed, much of the early empirical literature uses U.S. data to examine the relationship between bank profitability (or prices) and concentration. For example, examining U.S. banks in more concentrated local markets (as measured by HHI or CRn), Berger and Hannan (1989) and Hannan (1991) found these banks charge higher rates on SME loans and pay lower rates on retail deposits. Furthermore, Hannan and Berger (1991) and Neumark and Sharpe (1992) find that the deposit rates for such banks are slow to respond to changes in open-market interest rates.

Hannan and Liang (1993) use time-series data on monthly deposit rates (for several different deposit categories) for a random sample of 300 banks included in the Federal Reserve System's surveys of deposit rates, in order to test for the existence of market power. The sample period extends from October 1983 to May 1989. In addition, the authors also seek to determine whether the estimates obtained differ across both markets and banking products, in a manner consistent with hypothesised differences. Based on the observed relationship between deposit rates and security rates (adjusted for operating costs) over time, a test that can reject perfect competition (perfect price-taking behaviour) is developed by the authors. They report that, for the majority of banks, the hypothesis of perfect price-taking behaviour can be rejected in favour of behaviour based on the assumption that banks are each faced with a deposit supply curve that is upwards sloping to some extent. The results also show evidence that banks exercise greater market power in the case of money market deposit accounts than long-term certificates of deposits. Finally, the authors also find evidence to support the hypothesis that banks operating in more concentrated local markets exert greater market power in the pricing of money market deposit accounts, whereas this is not true in the pricing of long-term certificates of deposits.

Heitfield and Prager (2004) analyse interest rates paid on interest checking (NOW) accounts, savings accounts and money market deposit accounts (MMDAs) to test two assumptions. Namely, markets for at least some types of banking products are local in scope, and market concentration measures can serve as effective proxies for banks' abilities to extract monopoly rents. The authors use balance sheet data for most banks operating in the US in 1988, 1992, 1996 and 1999. For both NOW and MMDA accounts, the authors find that geographic markets appear to be smaller than state-wide. For savings accounts, the authors find that the hypothesis of state-wide markets cannot generally be rejected, except in the case of 1992. Examining the effects of concentration measures on interest rates, the authors report that local concentration measures are negatively related to rates paid on NOW accounts for all years considered, across all market specifications and for all concentration ratios employed. A negative relationship between local concentration and the deposit interest rate for savings accounts is also uncovered in most of the cases considered. The results for the MMDA accounts are weaker, however overall findings support the view that local market concentration is an important influential factor in the pricing behaviour adopted by banks. The authors also report strong evidence of a negative relationship between state-level concentration and deposit interest rates offered on NOW and MMDA accounts, which holds true even in markets that are not state-wide. The authors therefore argue that this indicates that the SCP paradigm, which assert that pricing power is driven solely by market concentration, may be too simplistic.

Jackson (1997) examines price rigidity (speed of adjustment of consumer deposit rates) using a dataset of US monthly survey data for the period December 1983 to November 1985, across high, medium and low concentrated markets. Employing

rational distribution lag and partial adjustment models, the author reports greater price rigidity in both low and high concentrated markets, compared to that exhibited in the medium category.

Martin, Saurina and Salas (2005a) investigate the existence and determinants of interest rate dispersion in loans and deposits using a dataset comprising two hundred Spanish banks and more than thirty products for the time period 1989 to 2003. The authors find persistent interest rate dispersion across loan and deposit markets, as well as across products, which they attribute to variables that affect the private net benefits of consumers' investment in information (including search costs). Furthermore, product specific inflation, rather than changes in the interest rate of the economy, has a greater influence on interest rate dispersion. Finally, the authors report that interest rate dispersion has been effectively reduced by the Spanish Central Bank's regulation of standards of transparency. In Martin, Saurina and Salas (2005b), the authors investigate the level and determinants of retail banking interest rate differences among Spanish banks for the period 1989 to 2003. Supporting the relative version of the Law of One Price, the authors find evidence that interest rates of bank loans and deposits for twenty five products adjust to their long term values rather rapidly in response to external shocks. However, they also report that the evidence contradicts the absolute version of the Law. Finally, the authors also find that different credit risk across banks and loan products is an important factor influencing both short and long run interest rate dispersion.

Kwangwoo and Pennacchi (2009) develop a model of multimarket spatial competition, in which small, single-market banks compete with large multi-market banks (LMBs) for retail loans and deposits. Accounting for prior empirical evidence

that firstly, relative to small banks, LMBs have more standardised operations and thus set retail interest rates that are uniform across many local markets, and secondly, that they also have access to wholesale financing; competition is then analysed for retail loans and deposits when LMBs command a greater presence in local markets. The authors argue that LMB rates on retail loans will be significantly lower than smaller bank competitors if any significant funding advantage LMBs hold is not offset by a loan operating cost disadvantage. This is notably significant in more concentrated markets. Furthermore, competition for retail loans is intensified where there is a greater presence of LMBs, and also reduces smaller bank loan rates. Lending support to previous empirical studies, the authors also argue that greater market share by LMBs increases competition in small business lending, but reduces competition in retail deposit taking.

Sharpe (1997) examines the relationship between pricing and switching costs for the consumer deposits market. The author tests the hypothesis that the existence of household switching costs reduces the competitive pressures on pricing, using a dataset comprising panel data for deposit interest rates and proxies for exogenous consumer turnover in different markets. Two types of retail deposit accounts are considered, namely the six month certificate of deposit (CD6M) and the money market deposit account (MMDA). For the CD6M, the empirical results indicate that concentration has a significant negative impact on deposit interest rates, in both restricted and liberal branching markets. Using the proportion of movers as a proxy for the fraction of consumers facing relatively low switching costs, the author also reports evidence of a significant positive effect in restrictive branching states, but no apparent effect in liberal states. When examining MMDA interest rates, the results again suggest that concentration has a negative effect on deposit rates, while the proportion of movers has

a positive effect. However, in this case, concentration has a much greater effect in markets where there exist a relatively large proportion of movers, while the proportion of movers only has a significant effect in less concentrated markets.

Numerous other authors have undertaken studies to test the link between concentration and higher profits. For instance, Corvoisier and Gropp (2002) examine the relationship between concentration and loan pricing using a European dataset. Competitive conditions, cost structures, and risk are all controlled for. Separate concentration and price measures for each of four products (loan, demand, savings, and time deposits) are developed, as different banking products may be affected differently by concentration. For loan and demand deposit markets, increased concentration is associated with less competitive prices. Beck, Demirgüç-Kunt, and Maksimovic (2004) assess the effects of concentration on credit availability while controlling for regulatory policies such as entry, ownership structure, and restrictions on bank activities. Using data for a number of developed and developing countries, their results indicate that in concentrated banking markets firms face higher financing obstacles. However, various factors can mitigate this negative effect, including efficient legal systems, less corruption, high levels of financial and economic development and foreign bank presence. Demirgüç-Kunt, Laeven, and Levine (2003) study the effect of concentration and various regulatory policies affecting competition on the net interest margins. Entry restrictions, restrictions on bank activity and restrictions on opening a bank are some of the policies considered. All are found to increase net interest margins. Furthermore, concentration is also correlated with higher margins, but when regulatory policies and general environmental factors (e.g. property rights) are controlled for, the effects become insignificant.

Further research examining whether high concentration endogenously reflects the market share gains of efficient firms was undertaken by authors including Smirlock, Gilligan, and Marshall (1984), Rhoades (1985), Smirlock (1985) and Shepherd (1986). The implications from this suggest that the analysis of performance should focus more on the conduct and strategic decision making of individual firms rather than on industry structure, as the performance of individual firms is largely determined by the differences in efficiency between firms. Various authors have attempted to address this issue. For example, Demsetz (1973) argues that a positive relationship between profit rates and concentration may be explained by differences in the levels of efficiency of the largest and smallest firms in the market, and may not necessarily be the result of more effective collusion in more concentrated markets.

3.2.2. Structure and Profitability.

Gilbert (1984) undertakes a survey of empirical studies which seek to uncover evidence on how the performance of depository institutions is influenced by market structure. Within this survey, the author examines studies which attempt to estimate the relation between measures of bank market structure and performance by applying the SCP hypothesis to banking. Bank market structure studies consider not only the theoretical basis for employing the structure-performance framework in order to analyse competition among banks, but also the issues involved in measuring performance and structure variables. Gilbert concludes from this survey that estimates of the influence of market structure on measures of bank performance are highly variable amongst studies, thus these earlier studies provided no conclusive evidence to support the structure-

performance hypothesis that higher market concentration leads to more effective collusion (less competition) among banks.

Berger et al. (2004) also provide a review of a number of papers that examine the impacts of bank concentration and competition on bank performance. The authors discuss the evolution of the literature, from the early 1990s when the empirical research typically tested the SCP hypothesis applied to U.S. banking industry data, to more recent research which tests a number of different models of competition, typically dynamic in nature therefore enabling the examination of the effects of bank consolidation over time. Furthermore, researchers have expanded the focus of their data from local U.S. banking markets to include other definitions of U.S. banking markets, in addition to studying banking data from other countries, including developing nations.

3.3. Efficiency; The Quiet Life Hypothesis and its application to banking.

As the research focus turned from the SCP hypothesis to bank efficiency, a large body of literature developed to examine efficiency issues such as scale (size), scope (product mix) and productive efficiency (technical and economic efficiency). Studies that examine scale and scope efficiencies address the question whether financial institutions produce the optimum output mix of services and financial products, in terms of both size of institution and composition of the output mix respectively. Thus, financial institutions are scale efficient when the size of their operations is optimal such that any change to the size of the institution would render it less efficient. Similarly, financial institutions are scope efficient when the product mix they provide (i.e. their degree of diversification) is such that further diversification would render the institution less

efficient. Studies which focus on productive efficiency examine whether banks utilise all of their resources efficiently, i.e. whether they produce the maximum output attainable from the least input. These studies address the question whether banks' use of resources is such that it maximises the production of services available (economic efficiency). Furthermore, they examine the effectiveness with which a given set of inputs (resources, technology and labour) is used to produce an output (technical efficiency). X-efficiency refers to the degree of efficiency maintained by financial institutions under conditions of imperfect competition. That is, under perfect competition, theory dictates that banks must maximise efficiency in order to make normal profit, those that do not will be forced to exit the market. The concept of X-efficiency asserts that firms may still exist in conditions of less than perfect competition, by operating inefficiently.

Berger (1995) examines the relationship between bank size, efficiency and market concentration and bank performance using U.S. data. More specifically, Berger evaluates the influence of market structure (measured by concentration), firm size and efficiency on bank performance by estimating a series of equations in which efficiency is controlled for. The results suggest that, typically, both larger and more efficient banks earn higher profits. Berger interprets these results as providing evidence that the relative market power (which is partly the result of product differentiation) of larger banks enables these banks to perform better than smaller banks. It is also reported that more efficient banks earn higher profits as a result of superior management techniques and technology, irrespective of bank size. Furthermore, Berger reports that bank performance is not significantly affected by market concentration and economies of scale.

More recently, research has expanded to analyse not only scale and scope economies, but also productive inefficiencies or deviations from the efficient production function/frontier. Measuring X-efficiency attempts to capture the efficiency of a bank (given its inputs, outputs, and prices) relative to other banks. An industry-wide 'best-practice' cost frontier is calculated and an individual bank's efficiency is based on its distance from the frontier (the distance is referred to as the bank's X-efficiency). There are three main approaches used to estimate the best-practice frontier. The stochastic frontier approach (SFA), the distribution free approach (DFA), and the thick frontier approach (TFA).

Berger et al. (1993) review the mainly U.S. literature, and show that X-inefficiencies explain approximately 20% of the costs faced by banks, while less than 5% of the costs are due to inefficiencies arising from failure to exploit scale and scope economies to the full. In their study, Frame and Kamerschen (1997), controlled for measures of X-efficiency and scale efficiency and allowed concentration and market share in local U.S. banking markets to be functions of these efficiency measures. Their results found some evidence favouring both the effect of market power and efficiency on profitability, but the results were generally weak and varied by market type. Using bank level data from the Call Reports for the period 1984 to 1999, and merger and acquisition information from the Board of Governors Merger and Acquisition database, Evanoff and Ors (2002) analyse the impact of entry on incumbent banks, in both urban and rural banking markets. The impact of both actual and potential competition resulting from market-entry mergers and reductions in entry barriers on bank cost and profit efficiency is evaluated. The analysis is conducted using X-efficiency measures generated from the estimation of annual cost frontiers and alternative profit frontiers.

The authors report that, consistent with economic theory, as mergers occur, incumbent banks respond to the increased competition by reducing their costs and improving their level of efficiency. The increased efficiency is in addition to the efficiency changes, arising in response to the increase in potential competition, and as a result of the initial elimination of entry barriers. Furthermore, the authors also report that again consistent with economic theory, new entrants via mergers consequently encourages incumbent firms to adjust to the more competitive environment by increasing their productive efficiency. Overall the results suggest that an improvement in competition is associated with higher X-efficiency.

Research and public policy concerns regarding concentration in product markets have typically considered only the social loss that arises in highly concentrated markets in which incumbents are able to exercise market power. As a result of the higher prices charged in these markets, output is restricted relative to the competitive level and thus there is a misallocation of resources. The welfare triangle (which represents the difference between the loss in consumer surplus and the gain in producer surplus as a consequence of non-competitive pricing) is typically used to demonstrate the social cost of this misallocation of resources. Studies that have attempted to measure this loss have mostly produced extremely low estimates. In addition, there are several mechanisms through which market power may lead to both greater operating inefficiency as well as higher costs. Numerous authors, including Williamson (1963) and Leibenstein (1966), report significant cost differences within industries as a result of inefficiencies. Scherer (1970) speculated that concentration may lead to efficiency costs as high as 10% of total costs, a significantly greater estimate than the welfare triangle measurement of social loss arising as a result of mispricing. Another social loss associated with concentrated

markets, the exercise of market power and reduced competitive pressures, is a less concerted effort by managers to maximise operating efficiency. Inefficient management practises may therefore result in higher cost per unit of output in concentrated markets, in addition to the higher prices and reduced output that arise when incumbent firms are able to exercise market power. Inefficient management practises leading to operating inefficiency, is referred to as the quiet life effect. That is, in highly concentrated markets, firms are able to charge prices above the competitive level. Managers may opt to forego a proportion of higher profits in order to benefit instead from a 'quiet life' whereby they do not have to work as hard to minimise costs. Berger and Hannan (1998) seek to investigate the application of the quiet life hypothesis to the commercial banking industry. Efficiencies are measured against the same national efficient frontier for more than 5000 banks with similar availability of close substitutes (relatively homogenous products), access to virtually the same technology, but located in different local markets with different degrees of market concentration. This enables banks to charge different prices for their deposit and loan products in different local markets. Under these circumstances, the authors are therefore able to isolate the effects of concentration on efficiency, from other inter-industry influences such as differences in products, technology and external competition. The authors report that banks in more concentrated markets are less cost efficient than other banks, all else equal. The total effect of concentration on U.S. banking costs is calculated by applying the estimated relationship between concentration and efficiency on all commercial banks, which is then compared to the social welfare loss from higher prices as calculated by the welfare triangle. The results indicate that the efficiency cost of concentration is likely to be several times larger than the social loss measured by the welfare triangle. There are a

number of reasons why market structure may influence cost efficiency. Koetter et al (2012) estimate adjusted Lerner indices (to account for the possibility of foregone rents) for a large sample of U.S. commercial banks in order to test the quiet life hypothesis that banks with market power incur inefficiencies rather than reap monopolistic rents. The authors report that Lerner Indices adjusted for profit inefficiencies indicate that U.S. commercial banks do in fact enjoy a quiet life, while instrumental variable regressions reject the quiet life hypothesis for cost inefficiencies.

3.4. New Empirical Industrial Organisation.

Over time new methods, collectively termed as the New Empirical Industrial Organisation (NEIO) approach, were developed to counter the problems inherent in the SCP approach. This approach focuses on bank level conduct/strategy by examining how prices (and in some instances quantities) respond to changes in competitive conditions (such as increases in costs). From an examination of such behaviour we can infer whether the market under consideration can be characterised by competition or collusion. The two main empirical techniques implemented within this literature designed to test conduct directly, are the Panzar-Rosse (PR) and Bresnahan-Lau (BL) approaches.

The markup test of Bresnahan (1982, 1989) and Lau (1982), involves estimating a structural model with separate demand and supply equations. This method measures market power by parameterising the markup of price over estimated marginal cost. The Panzar-Rosse revenue test involves estimating a reduced form equation in which gross revenue is related to a vector of input prices and other control variables.

3.4.1. The Bresnahan Lau (markup) test.

The fundamental principal underlying the BL test is that under equilibrium conditions, profit maximizing firms will choose prices or quantities such that marginal cost equals the perceived marginal revenue. Under perfect competition this coincides with the demand price, and under perfect collusion with the industry's marginal revenue.

The true marginal revenue function is represented as $P + h(Q, Y, \alpha)$, where P is the industry price, Q is the industry's aggregate output quantity, Y is a vector of exogenous variables, α is a vector of demand system parameters to be estimated and $h(\cdot)$ the semi-elasticity of market demand $Q/(\partial Q/\partial P)$, where $\partial Q/\partial P$ is derived from a separately estimated market demand function (Bresnahan, 1982). The average firm's perceived marginal revenue is represented by $P + \lambda h(Q, Y, \alpha)$. From this equation, λ is defined as a parameter indexing the degree of market power of the average firm in the industry. When $\lambda = 0$, the industry is competitive with price equal to marginal cost. When $\lambda = 1$, the industry is defined by perfect collusion whereby firms act to maximise joint profits. Values of λ between 0 and 1 describe varying degrees of imperfect competition or market power. The structural model in this approach consists of a market demand function and either an individual or average firm supply function. The model can be estimated using either industry aggregate data (as originally derived by Bresnahan, 1989), or firm-specific data (including Shaffer 1999, Shaffer and DiSalvo 1994, and others).

The estimates of conduct obtained when using aggregate data are asset-weighted averages of the underlying bank-specific parameters. The industry's marginal cost

function is calculated as the horizontal summation of the constituent banks' marginal cost functions.

A number of studies have applied the markup test to banking data, including Shaffer (1989, 1993, 1999, 2001), Berg and Kim (1994), Suominen (1994), Gruben and McComb (2003) and Angelini and Cetorelli (2000) who incorporated some variation in their version of the model. The major advantages of the test are a test statistic which is easily interpreted, the capacity to use industry aggregate data, and a direct relationship to a natural measure of excess capacity, which ultimately produce a means of accurately measuring conduct, even if demand and costs are imperfectly measured.

Shaffer (1989) applied the BL technique to the U.S. banking industry, with the results strongly rejecting collusion, but not perfect competition. In addition, Shaffer (1993) also employed the BL technique to test Canadian banking market contestability for the period 1965 to 1989. The results show that banking behaviour was consistent with perfect competition over this period. A slight, but statistically significant, increase in competition is found after 1980, at which time changes were made to the Bank Act.

Various other studies have been undertaken using the BL procedure. These include Berg and Kim (1998), in which results for retail vs. corporate banking markets were compared using the BL procedure. Shaffer (2001) analysed competition in 15 countries in Europe, North America and Asia using the BL technique, and reported varying results for the different countries.

3.4.2. Panzar-Rosse Method.

The Panzar and Rosse H-statistic (1982, 1987) captures the elasticity of bank interest revenues to input prices, by calculating the H-statistic. The H-statistic is generally interpreted as a measure of the degree of competition in the banking market, and only offers a valid estimate if the market is in long-run equilibrium whereby return on bank assets is not related to input prices.

H can be estimated using a log-linear regression in which the dependent variable is the natural logarithm of total revenue and the explanatory variables include the logarithms of each input price, typically along with other control variables.

$$\ln(P_{it}) = \alpha_i + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) + \gamma \ln(Z_{it}) + \delta D + \varepsilon_{it} \quad (3.1)$$

where i denotes banks and t denotes years. P is the ratio of gross interest revenues to total assets, which represents a proxy for the output price of loans. $W1$ is the ratio of interest expenses to total deposits and money market funding (proxy for input price of deposits); $W2$ is the ratio of personnel expenses to total assets (proxy for input price of labour) and $W3$ is the ratio of other operating and administrative expenses to total assets (proxy for input price of equipment/fixed capital). Z represents a matrix of control variables which includes the ratio of equity to total assets, the ratio of net loans to total assets, and the logarithm of assets (to control for bank size effects). Finally, D is a vector of year dummies and α_i denotes bank-level fixed effects. The H-statistic is calculated by $\beta_1 + \beta_2 + \beta_3$.

Panzar and Rosse demonstrated how the value of H is negative for a neoclassical monopolist, collusive oligopolist, or conjectural-variations short-run oligopolist. For a competitive price-taking firm in long-run equilibrium, or a firm employing a constant

markup pricing strategy, H is equal to unity; while for a monopolistic competitor H can take on values between 0 and 1. That is, under conditions of perfect competition, any increase in input prices will raise both marginal costs and total revenues by the same amount. In this circumstance, the H -statistic will therefore equal 1. Under monopoly conditions, an increase in input prices causes marginal costs to rise, output to fall, effecting a decline in revenues. Therefore, under a monopoly, the H -statistic is less than or equal to 0.

Shaffer (1982) applied the PR approach to a cross section of banks in New York State using data from 1979. The results support the rejection of the hypotheses of both monopoly and long-run perfect competition. Nathan and Neave (1989) use the PR model to test for competitiveness in the Canadian banking, trust, and mortgage industries over the three years 1982-1984. For the banking industry for each of those years the hypothesis of pure collusion is rejected. Bank revenues behaved as if earned under monopolistic competition, while perfect competition could not be ruled out for 1982. Tests for the trust and mortgage industries also reject pure collusion. Vesala (1995) also applied the PR test to banks in Finland, while Hondroyiannis et al. (1999) applied this method to the Greek banking system. In general, studies that applied the PR model to European banking systems found that both monopoly and perfect competition systems could be rejected in favour of monopolistic competition. Using this method, or minor variations of it, other studies have considered banking data from multiple European countries. For example, Molyneux, Lloyd-William and Thornton (1994) tested for contestability in German, British, French, Italian and Spanish markets, using a sample of banks from these countries for the period 1985-1989. The authors conclude that commercial banks in these markets operated in a monopolistically

competitive market. Other studies include Bikker and Groeneveld (2000) and De Bandt and Davis (2000), which both report evidence of some degree of market power in at least one subsample tested. Molyneux, Thornton, and Lloyd-William (1996), were not able to reject monopoly behaviour when applying the PR test on data for Japanese banks. Bikker and Haaf (2002) examine competitive conditions for 23 countries using the PR model. For all countries, the results are consistent with monopolistic competition. This is a typical result of the contestability literature. The authors attempt to formally relate competitiveness (as measured by the H-statistic) with market structure (the degree of concentration). Although they find that competitiveness is negatively related to concentration, the results are weak.

Claessens and Laeven (2004) build on this work by attempting to relate the competitiveness of a country's banking sector with structural and regulatory indicators of the financial system. They use panel data over the period 1994-2001 to construct H-statistics for 50 countries. Consistent with Bikker and Haaf, the authors find that the markets of each country exhibit varying degrees of imperfect competition. For some countries with a large number of banks, the authors find relatively low levels of competition (e.g. U.S.). The authors then attempt to identify factors that explain the contestability of banking sectors across countries. They regress the H-statistic on a variety of country statistics, such as the presence of foreign banks, activity restrictions on banks (to engage in security market, insurance, and real estate activities), the entry regime, market structure, competition from the non-bank sector, general macroeconomic conditions and the overall development of a country. Claessens and Laeven find that contestability is positively related to foreign bank presence, less-severe entry restrictions, and few activity restrictions. In all specifications contestability is

positively related to concentration and negatively related to the number of banks (statistically significant at the 5 and 10 per cent levels), depending on the specification.

Coccoresse (1998) and Hempel (2002) have also applied the PR test to banking datasets that include at least one European nation; while Gelos and Roldos (2002) and Philippatos and Yildirim (2002) have additionally included several developing nations in their studies. Shaffer (2002a) reports a rejection of the hypothesis of monopolistic pricing when the PR test is applied to time-series data from a monopoly bank.

Shaffer (2004) proposes two simple variations on the PR test and applies them to a selected sample of banks in order to examine patterns of competition in banking. The first variation accounts for the fact that physical capital is often fixed in the short run, thus precluding any immediate effect of its price on equilibrium revenues. The second variation is intended to mitigate the effects of an imperfectly elastic supply of bank inputs, by fitting a revenue equation to lagged input prices. The sample period used extends over 42 quarters, from March 1984 through June 1994, for four thrift banks. The author reports that for all four banks the H test statistic is significantly positive, therefore rejecting the hypotheses of monopoly. Furthermore, it is significantly less than unity, therefore rejecting the hypotheses of long-run competitive equilibrium, contestable markets, constrained size maximisation or fixed markup. The author provides further evidence that thrift institutions may be a source of significant competition to community banks, even in small numbers. Market power may also be small even in markets supplied by only one bank and one thrift institution.

Goddard and Wilson (2009) undertake a study of competition in banking which offers a methodological contribution to the existing literature in the form of an

investigation of the implications for the estimation of the H-statistic of a form of misspecification bias in the revenue equation. That is, misspecification bias arises in the situation where there is partial, not instantaneous, adjustment towards equilibrium in response to factor input price shocks, thus necessitating the inclusion of a lagged dependent variable among the covariates of the revenue equation. The study examines the implications for the estimation of the Rosse-Panzar H-statistic of departures from assumed product market equilibrium conditions for the G-7 countries by applying FE (static revenue equation) and GMM (dynamic revenue equation) estimators of the H-statistic to unconsolidated company accounts data for six national banking sectors for the period 1988 to 2004. The principal finding of this study is that a dynamic, rather than static, formulation of the revenue equation should be used to identify the Rosse-Panzar H-statistic as most countries are characterised by positive short-run persistence and partial adjustment. The H-statistics obtained using both FE and GMM are also consistent with the conclusion that the FE estimator of the H-statistic is biased towards zero.

Bikker et al (2012) apply the PR model in order to ascertain the role of scale, costs and equilibrium in terms of competitive conduct. The authors demonstrate that neither a price equation, nor a scaled revenue function, yield a valid measure for competitive conduct. In particular, they demonstrate that a price equation or a scaled revenue equation produces a poor measure of competition for industries characterised by oligopoly or monopoly. Moreover, even the use of an unscaled revenue function is not appropriate without the introduction of further variables that allows us to assess whether the market is in equilibrium. This is important because should the market not be in equilibrium then even a competitive bank can have an H statistic of less than zero,

indicating a monopolist or oligopolist. The authors undertake an empirical analysis of competition in banking using a sample in excess of 100000 bank-year observations for more than 17000 banks in 63 countries for the period 1994 to 2004. For each country, the authors estimate the H-statistic using three different versions of the PR model. That is, H based on an unscaled revenue function, a revenue function with total assets as the explanatory variable and a price function with total revenue divided by total assets as the dependent variable. They confirm their theoretical model that only an unscaled revenue equation can yield a valid measure for competitive conduct.

In a related context, Delis et al (2008) also argue that some standard measures of competition (Bresnahan-Lau and Panzar-Rosse) can underestimate the degree of market power when using a static empirical formulation. Using an empirical example for the markets of Greece, Latvia and Spain, they demonstrate that a dynamic panel reformulation of the static equations for the measures of market power lead to more accurate estimates of competition over their static counterparts. Although the paper notes that the dynamic panel modelling approach increases estimation complexity and that their results may have elements that are specific to the data considered, they argue that the results can reveal elements of collusion missed by the standard approach and the broader considerations are worth further investigation.

One of the weaknesses of the PR approach, which is relevant to all of the cited studies above, relates to the geographic extent of the true market for banking services. That is, for most countries the relevant market is smaller in geographic scope than the country itself. Therefore, a country-wide measure of competitiveness may be misleading, as it represents an average of values that differ widely across local areas within a given country. The implication for this is that country-wide measures of

market structure do not accurately measure the market structure that is relevant to the behaviour observed.

Carbo et al (2009) undertake a review of cross-country comparisons of competition and pricing power in European banking. In order to examine whether different measures of competition yield similar results, the authors compare structural and non-structural indicators of competition across European banking markets for the period 1995-2001, in particular using measures from the NEIO approach. Furthermore, they identify a number of bank-specific and country-specific factors that explain differences in structural and non-structural measures of competition. The authors note that existing indicators of competition tend to give conflicting predictions across countries, within countries and over time. Finally the authors employ a procedure developed in the frontier efficiency literature to identify a new indicator of bank pricing power. Their results indicate that when differences in cost efficiency, fee income, real output growth and inflation are taken into account, then European banks' pricing power appears weaker than indicated by other traditional competition indicators.

3.5. Other Approaches: Persistence of Profits.

The persistence of profits (POP) refers to the ability of firms to earn abnormal profits which, in a competitive market, would otherwise be eliminated by market forces. The POP strand of literature emerged in the 1970s as a revisionist critique of the prevailing structure, conduct, performance paradigm (SCP) put forward by Bain (1956). The POP approach argues that the differences across firms are more significant than those differences between industries, and hypothesises that in the absence of barriers to entry,

competitive market forces will erode any abnormal profits in the long run. Thus, a competitive market in which firms earn above normal profits should encounter entry by new firms. These new firms compete directly with existing firms, by offering identical products at lower prices, forcing the latter to reduce prices. Consequently, profits are also reduced to the point whereby the competitive rate is once again achieved. The reverse competitive process is apparent in markets where firms earn below normal profits. In this instance firms either exit the market, or undertake action to return their profit rate to the competitive level.

A central premise of the SCP approach is that profit differentials between firms within a particular industry occur as a result of the structure of that industry (e.g. the level of industry concentration). The persistence of these profit differentials is also explained by industry structure. Typically, tests of the SCP approach estimate cross-sectional regressions of a measure of profitability on an index of market concentration and other explanatory variables (including expenditures on R&D and advertising).

Seminal contributions by Mueller (1977, 1986) paved the way for a body of literature which sought to examine the dynamic structure of a company's profits by employing the persistence approach. Mueller (1977) tests the competitive environment hypothesis by examining whether profits converge to a single mean value over time. As each time period brings new random shocks, firms never achieve a conventional stable equilibrium. Thus, although abnormal earnings decay towards the competitive level, individual firms' access to specialist knowledge (or other advantages unavailable to competitors) allows for long run persistence of profits. Mueller estimates a set of firm specific regressions in which the dependent variable is profit rate, and the independent variable is a deterministic, decaying time trend. For the majority of firms yielding

above average profits at the start of the sample period, the coefficient on the time trend was found to be negative. Conversely, a positive coefficient was obtained for the majority of firms yielding below average profits at the start of the sample period. The results of this study suggest that there is a tendency for profit rates to converge over time, as competitive pressures eliminate abnormal profits and restore equilibrium. However, it is also noted that for a significant number of firms, the trend coefficients obtained were either small or incorrectly signed; suggesting that, in many cases, it is highly probable that convergence will take place slowly, if it occurs at all.

Mueller (1986) developed a stochastic time series model, which subsequently provided the basis for the majority of research into the persistence of profits. This study demonstrates how persistence of profits can be estimated using a simple first order autoregressive equation. Examining Federal Trade Commission (FTC) survey results for the period 1950-1972, and extending his original sample to include 551 firms, Mueller found evidence of significant persistence in the ranking and profitability of very high and very low performers.⁴ These findings again indicate the persistence of long-run profitability differences across firms, with the most profitable group of firms earning profits of 30 percentage points above the norm in the long run.

Geroski and Jacquemin (1988) and Geroski (1990) employ a similar methodology to Mueller (1986), in order to examine the profit performance of 134 large firms in the UK, West Germany and France, for the period 1949-1977. Their evidence suggests that there is both less variation in profits, and that there is greater profits persistence over time for UK firms. In contrast, evidence for France and West Germany

⁴ Using the profit history of the largest 1000 US corporations.

indicates that firms have larger variations in profits and profit rates tend to converge more quickly to the industry average.

The persistence of profits literature, which builds on the early work of Mueller, Geroski and Jacquemin, typically reports large measures of profits persistence which differ from the competitive equilibrium of normal profits. Examples include Cubbin and Geroski (1990), Schohl (1990), Droucopoulos and Lianos (1993), Kambhampati (1995), Goddard and Wilson (1996, 1999), McGahan and Porter (1999) and Glen et al (2001). A number of studies have incorporated the effects of abnormal profits resulting from entry and exit barriers as well as the benefits associated with first-mover advantage when measuring the persistence of profits. The results still indicate that profits persistence is too high. For example, Mueller (1990) examines a number of West European and North American economies, and concludes that profits do persist across time. Maruyama and Odagiri (2002) examine a selection of Japanese firms and also report that profit persistence is too high. Analysing US firm data, Gschwandtner (2005), reports profits persistence for a period exceeding 50 years.

Numerous studies that differ according to both country and the time period considered have consistently reported persistence of profits. Such studies include those undertaken by Odagiri and Yamawaki (1986, 1990a,b), and Odagiri and Hayawaki (1990) and Maruyama and Odagiri (2002) for Japan. For the UK, authors include Cubbin and Geroski (1987, 1990), Goddard and Wilson (1996, 1999), Gschwandter (2005), Gschwandter and Hauser (2008) and Cable et al (2001). Geroski and Jacquemin (1988) for the UK, France and Germany, Schwalbach, Grasshof, and Mahmood (1989), Schwalbach and Mahmood (1990) and Schohl (1990) for Germany, Khemani and Shapiro (1990) for Canada, Mueller (1990a) for many countries, Mueller (1990b),

Waring (1996), McGahan and Porter (1999) for the US, Kambhampati (1995) for India, Glen et al. (2001) for nine developing countries, Ioannidis, Peel, and Venetis (2003) and Yurtoglu (2004) for Turkey.⁵ Both Yurtoglu (2004) for Turkey and Glen et al. (2001) for seven emerging markets⁶ report levels of persistence no less than those levels measured in developed economies. Table 4.1 presents a brief summary of a selection of studies that measure the persistence of profits.

When analysing firm level profitability data, the existence of a unit root within the series should indicate that any shocks to profitability last indefinitely until the occurrence of the next shock. In this circumstance, differences in profitability remain, and are not eliminated via competitive pressures. The Augmented Dickey-Fuller (ADF) test, which tests for stationarity, is one such unit root test often used within the literature. However, as noted by Crespo Cuaresma and Gschwandtner (2006), one common problem with these tests is the low power they have against a stationary alternative. Yurtoglu (2004) uses Dickey-Fuller (DF) tests that fail to reject the null hypothesis in only 56 out of 172 cases.

A number of studies have considered autoregressive models with lag lengths greater than one. The consensus from this literature suggests that a lag length of one is sufficient. For instance, Goddard and Wilson (1999), using a dataset comprising 335 UK firms for the period 1972-1991, find support for partial short-run persistence of profits ($0 < \lambda_i < 1$) for all firms (although they were unable to rule out the possibility of zero persistence ($\lambda_i = 0$) for up to 15% of firms, or complete persistence ($\lambda_i = 1$) for up

⁵ Mueller (1990a) analyses profit persistence in seven developed countries (Canada, France, Japan, Sweden, UK, US, and West Germany). He concludes that profit persistence exists in all of these countries.

⁶ Brazil, India, Jordan, Korea, Malaysia, Mexico, Zimbabwe.

to 24% of all firms. The authors also examine the persistence of long run profit and seek to determine whether long run profits rates revert to their competitive equilibrium. They conclude that whilst long run profits are normally distributed around zero, their results suggest that there is no convergence on long run profit rates for all firms. Kambhampati (1995) also finds that coefficients on lags in an autoregressive model greater than one were typically insignificantly different from zero. Geroski and Jacquemin (1998) using a dataset comprising UK, French and West German firms, found that more than 82 percent of UK, 95 percent of French and 79 percent of West German firms had coefficients equal to zero on autoregressive lags greater than one. Similarly, Yurtoglu (2000) analysed a dataset comprising Turkish firms and found that 92 percent had insignificant parameters on lags greater than one.

Although the above studies suggest that the AR(1) model is the appropriate specification and thus applying the AR(1) equation to all firms should not change the pattern of results, several studies have nevertheless extended the AR(1) methodology. These include Gschwandtner and Hauer (2007), who adopt a fractional integration approach in order to analyse the dynamics of profits for 156 US manufacturing companies that survived for the period 1950 to 1999, and uncover evidence of long-range dependency and non-stationarity. Crespo Cuaresma and Gschwandtner (2006) employ a non-linear three-regime threshold autoregressive model with a middle random walk regime and symmetric reverting outer behaviour. Their results suggest lower levels of persistence than typically reported in linear modelling. Cable and Jackson (2008) adopt structural time series analysis in order to identify structural breaks, trends and cyclical behaviour. Structural time series is also considered by Cable and Gschwandtner (2008) who use the standard AR(1) model on a sample of 156 US

companies over a 50 year period to compare results with an alternative model that adopts a structural time series approach. The authors found that both models were able to identify firms with profits persistently above or below competitive norms, however they report that the structural time series method detects a much higher overall incidence of persistence. Thus, they suggest that the latter model is more suitable than an AR(1) model in cases where the profit dynamics are more complex. McMillan and Wohar (2011) estimate a threshold autoregressive model that allows for asymmetry in the strength of persistence between above and below mean profits. This enables differentiation between entry and exit as the drivers of the competitive equilibrium. Gschwandtner (2012) estimates a time varying state space model AR(1), employing a method developed by Crespo Cuaresma and Gschwandtner (2008), whereby the profit persistence is allowed to change each period.

The following section provides a review of those studies that seek to explain, as opposed to merely estimate, the persistence of profits. McGahan and Porter (1999) construct a dataset comprising a large number of US companies for the period 1981 to 1994 in order to examine the persistence of incremental industry, corporate-parent and business-specific effects on profitability. Their results suggest that incremental industry effects impacts the longest on profitability persistence. Furthermore, changes in industry structure rather than changes in firm structure have a more persistent impact on profitability.

Yurtoglu (2004) examines firm level profitability in Turkey. Central to this analysis of profit persistence are three questions relating to industry dynamics; (i) are excess profits successfully eliminated via competitive forces (ii) how long does the process of eliminating excess profits take and (iii) to what factors can observed

differences in profit persistence and speed of adjustment to the norm, be attributed? The author concludes that the intensity of competition in Turkey is no less than in developed countries. Glen et al.(2001) examine the persistence on profitability and competition for a dataset comprising seven emerging markets. Their results suggest that intensity is greater in emerging markets than developed economies.

Gschwandtner (2005) examines 85 surviving firms and 75 exiters over the period 1950-1999 in response to a significant limitation of previous studies, namely that they consider only surviving firms. The author reports that while there is evidence of profit persistence for both samples, exiters perform more competitively than surviving firms. Furthermore, the author identifies concentration and growth of the industry, size and volatility of profits as factors that have a significant influence on persistence. When examining survivors, Gschwandtner finds that profits generally converge to a competitive norm, in line with the existing literature, but there is a considerable degree of profit persistence such that even after a fifty year period the adjustment process is still not fully completed. A possible explanation suggested by the author relates to industry concentration, whereby highly concentrated industries are potentially able to construct entry barriers and therefore elicit a high degree of profit persistence. Various studies have found a positive relationship between concentration and different measures of profitability (e.g. Kambhampati, 1995; Yurtoglu 2004).

Another industry characteristic that would be expected to impact on profits persistence is the size of the industry, measured by the number of firms in the industry. Typically, the larger the number of firms in the industry the more competitive it is and therefore the lower the persistence of profits. In addition, the growth rate of the industry is also an important factor in explaining profit differentials, although studies

have demonstrated that its net effect is ambiguous. That is, in industries experiencing rapid growth it might be harder for firms to maintain their market share and oligopolistic discipline and as such profits might decrease. Conversely though, in industries that are experiencing rapid growth, firms are under no pressure to reduce prices in order to increase sales and thus profit differentials may be maintained over time. Kambhampati (1995) analysing industry growth and profit persistence, found a positive and small, but highly significant, coefficient. Furthermore, Gschwandtner (2005) highlights the importance of both firm and industry size and growth in determining profit persistence using data from US surviving and exiting firms.

Droucopoulos and Lianos (1993) investigate convergence in industry-level average profit rates for a dataset of 20 Greek manufacturing industries over the time period 1963-88. The speed of adjustment towards long-run equilibrium (measured by $\hat{\lambda}_i$) is typically slow. That is, results for the values of $\hat{\lambda}_i$ are found to be relatively high for most industries, and in some cases exceed 0.9 (implying that 90% of any abnormal return earned in year t persists into year $t+1$). Large values for Π_{ip} (long-run profitability differences) are also obtained, which range from 11.8% (for the tobacco industry) to 38% (for the footwear industry). In order to determine the factors affecting $\hat{\lambda}_i$ a cross-sectional analysis is applied to the following model:

$$\hat{\lambda}_i = \beta_0 + \beta_1 CR_i + \beta_2 A/S_i + \beta_3 EFF_i + \beta_4 EX/S_i + \beta_5 STR_i + \mu_i \quad (3.2)$$

Where CR_i is the concentration of employment amongst the largest four firms; A/S_i is the advertising expenditures to sales ratio; EFF_i is the percentage of manufacturing employment accounted for by foreign firms; EX/S_i is the ratio of exports to sales, and STR_i is the number of strikes. The results indicate a significant negative relationship of

$\hat{\lambda}_i$ to CR_i , A/S_i and EX/S_i which suggests that high concentration, high advertising intensity and ratio of exports to sales are all instrumental in slowing the speed of adjustment to long-run equilibrium profit values.

Waring (1996) examines industry aggregates for 12,986 US firms for the period 1970 to 1989. The author reports that the convergence process is industry specific. Furthermore, industry characteristics such as levels of R&D have a significant impact on the speed of convergence.

Eklund and Wiberg (2007) analyse the links between the persistence of profits and the systematic search for knowledge. The authors observe that firms which invest in research and development may potentially create products or services that are preferred by the market, or potentially develop a more cost efficient method of production. Thus, firms which systematically invest in research and development may potentially earn persistently high profits. Furthermore, the authors argue that profit persistence may occur even without the existence of significant entry and exit barriers, which they accredit to the systematic search for knowledge through research and development.

Jacobson and Hansen (2001) model the process of competition as reflected in the persistence of abnormal returns for both US and Japanese firms. For the US, the authors include accounting data for a total of 1039 firms taken from the 1992 Standard and Poor's Compustat annual industrial file, for companies listed in the NYSE, AMEX and NASDAQ stock exchanges. Inclusion criteria required that a firm reported both its net income and assets for the entire 20 year period from 1973 to 1992. In addition, the firm had to be non-financial and have a minimum of three other firms represented from

the same industry. For Japan, annual balance sheet and income statement items come from the Japan Development Bank. Firms included in the sample are part of the First Section of the Tokyo Stock Exchange (of which there are two sections). A total of 271 Japanese firms were included in the sample, covering the period March 1973 to March 1993. The authors uncover similar aggregate distribution of firm persistence in both countries, whilst observing differences in industry persistence across the two countries. The authors conclude that both firm specific and industry specific factors influence firm persistence.

Bentzen et al. (2005) employ a dynamic framework in order to examine profit persistence for nearly 1600 Danish firms over a twelve year time period. The authors report that, compared to other studies, the speed of convergence towards industry norms is relatively high. Therefore, within industries, the competitive process appears to work well; however, the authors also report significant variations in profit persistence across industries. Following the usual two-step methodology e.g. Mueller (1990) and Geroski and Jacquemin (1988), the paper reports that firm specific characteristics (for instance firm size, market share, type of ownership and ownership concentration) have a mixed effect in determining profit persistence. For instance, the authors report an increase in profit persistence if the largest owner of a firm holds up to 50% of the stocks. Beyond this threshold, further owner concentration has a negative effect on persistence, causing it to decrease. Furthermore, the authors report that firm specific characteristics have no significant influence on permanent profits, suggesting that unobserved firm characteristics are more influential in determining profit levels.

3.5.1. Persistence of profits in banking.

There now exists a large empirical literature which seeks to assess competition in the banking industry by examining the persistence of profits. Early research was based on the Structure-Conduct-Performance paradigm and the subsequent Chicago Revisionist School critique. The former contested that a small number of banks may be able to collude (or use independent market power) in order to push prices up, therefore enabling banks to earn abnormal profits. The latter contested that banks may earn abnormal profits as a result of increased efficiency gains arising as banks increase in size (thus more concentrated markets are inherently more profitable). The extent to which banks are able to earn high profits either through the exercise of market power, or as a consequence of superior efficiency, has never been satisfactorily resolved (e.g. Goddard et al., 2007; Casu and Girardone, 2006; Dick and Hannan, 2010).⁷

Levonian (1993) examines the speed with which abnormal profits are eroded within the US banking industry. The author develops a method which utilises stock market and financial accounting data from a cross-section of banking firms, to infer the persistence of economic profits. This method derives a rate of profit adjustment that is most consistent with the observed cross-sectional relationship between stock prices and profitability. In this model, a slower implied rate of adjustment suggests that the market considers bank profits to be more persistent. The dataset comprised 83 surviving banks and bank holding companies with exchange-traded shares for the period 1986 to 1991, obtained from the Standard and Poors' Computstat database. Using pooled data, the

⁷ Other examples of studies that assess the determinants of bank profits at individual or cross-country level include Molyneux and Thorton (1992), Berger (1995), Demirguc-Kunt and Huizinga (1999), Mamatzakis and Remoundos (2003), Staikouras and Wood (2004), Athanasoglou et al. (2006), Micco et al. (2007), Pasiouras and Kosmidou (2007), Athanasoglou et al. (2008), Tregenna (2009) and Dietrich and Wanzenried (2011).

author employs a nonlinear least squares technique. The results show that while the expected rate of adjustment tends to be significantly greater than zero, adjustment speeds are slower than for nonbank firms.

Berger et al (2000) analyse persistence in the US banking industry. This study employs a non-parametric methodology in order to examine exogenous propagation mechanisms of persistence. Propagation mechanisms are identified as local market power, informational opacity and regional macroeconomic shocks. Results indicate that both local market power and informational opacity are strongly correlated with profit persistence. Furthermore, bank performance is affected by regional macroeconomic shocks. Thus, the authors report that US banking industry profit converges to its long-run average value more slowly than profit convergence within the manufacturing industry.

Roland (1997) uses a two-dimensional model to measure persistence within the banking industry. The performance persistence for individual firms was separated according to the tendency for various revenues to persist and the tendency for various costs to persist. The degree of persistence was allowed to differ cross-sectionally. The model produced a unique performance classification system which allows a BHC to be categorised according to the level of abnormal profits generated and how persistent these profits are. The dataset comprised quarterly data obtained from the Consolidated Financial Statements for Bank Holding Companies (FR Y-9 C) submitted to the Board of Governors of the Federal Reserve System, for the period June 1986 to December 1992. The results suggest that persistent positive abnormal profits appear to be driven by revenue generation and not cost control. Evidence also indicates that, as a result of entry barriers, a significant number of BHCs yield persistent negative abnormal profits

(although Roland also notes that this may no longer hold true if enough barriers are removed as a result of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994).

Goddard et al. (2004a) employ a model that incorporates bank-specific variables such as size, diversification, risk and ownership type to a sample of European banks from six countries in order to estimate the persistence of profit. Commercial banks are found to have lower persistence of profits than mutual (savings and cooperative) banks. Furthermore, persistence is found to be highest in France, which may be the result of a strong regulatory framework that effectively protects banks from the full effects of competition. In another study by Goddard et al. (2004b), the authors employ dynamic panel and cross-sectional regressions in order to estimate growth and profits equations for a dataset comprising 583 banks; consisting of a sample of commercial, savings and cooperative banks from five major European countries during the mid-1990s. Annual observations for growth and profits rates are observed for the period 1992 to 1998, in addition to a set of control variables designed to capture the impact of a number of characteristics at the firm-level, industry-level and macroeconomic level. The results of the growth regressions show little or no mean reversion in bank sizes (i.e. as banks become larger in relative terms their growth performance also tends to improve). However, the authors find no evidence of any cross-sectional relationship between bank size and growth. The results do indicate that profit is an important prerequisite for future growth, banks with higher capital-assets ratios typically experience slower growth and furthermore, macroeconomic conditions affect growth also. Savings and co-operative banks appear to have greater persistence of profit than commercial banks. High capital-assets or liquidity ratios are typically observed in banks with relatively low

profitability; and finally, the authors uncover some evidence of a positive correlation between concentration and profitability (lending support to the SCP hypothesis) but no significant evidence of a correlation between bank-level x-inefficiency and profitability.

Knapp et al. (2006) estimate persistence for a sample of US banks and find that profit may take five years or so to revert to the industry mean. Athanasoglou et al. (2008) estimate persistence using Greek data, while Flamini et al. (2009) undertake a cross-country study for Sub-Saharan Africa and finds that there is a strong positive correlation between strong persistence and bank size, diversification and private ownership.

Bektas (2007) investigates the persistence of profits in the Turkish banking sector using a dataset comprising 28 surviving banks for the period 1989 to 2003, and finds that profits do not persist in the long run, as any abnormal profits are eroded by competitive forces.

Goddard et al (2010) employ a dynamic panel model to examine the determinants and convergence of bank profitability using a dataset comprising eight European Union member countries (Belgium, Denmark, France, Germany, Italy, Netherlands, Spain and the UK) for the period 1992-2007. In line with the literature, the authors employ an AR(1) model to estimate bank profitability. However, in contrast to previous bank POP studies, they utilise the excess return on equity (eROE) as the dependent variable in order to account for the possibility that the cost of capital varies between countries. The results indicate that more efficient and diversified banks have higher average profitability in contrast to highly capitalised banks which are characterised by lower average profitability. They also find that excess profit tends to

persist from one year to the next. The authors also consider two sub-periods within the data, the first one being from 1992-1998 and the second one from 1999-2007. Estimations for these sub-samples indicate that persistence of profit was lower in the second period than in the first for all eight countries. This is consistent with the hypothesis of an increase in the intensity of bank competition resultant from an increase in the integration of EU financial markets following the introduction of the euro in 1999 and the implementation of the Financial Services Action Plan.

In a more recent paper, Goddard et al. (2011) undertake further cross country analysis of the persistence of profit in banking. The authors find evidence of greater profit persistence for banks in developed countries, than for those in developing countries. In particular, they find that banks located in East Asia are characterised by a relatively low degree of persistence compared to banks located in North America and Western Europe. They also find greater persistence in markets where entry barriers are high and competition low.

Goddard et al (2009) estimate country-level dynamic panel models for 65 national banking industries. They report that the persistence of profit is weaker for banks in developing countries than for those in developed countries. In particular, they note that North America and Western Europe display a relatively high degree of persistence, whereas East Asia and the Pacific, and Sub-Saharan Africa are characterised by relatively low persistence. The authors also report that persistence is stronger when entry barriers are high and when competition is low according to both structure and conduct based competition indicators.

Beckmann (2007) seeks to analyse both structural and cyclical determinants of banking profitability for 16 Western European countries for the period 1979 to 2003. Aggregate annual country data is collected, alongside banking group data for commercial, cooperative and savings banks. The authors employ panel methodology using the Hausman-Taylor instrument variable estimator. Their results indicate that financial structure is an important factor. In particular, they find that there is a positive association between a market based financial system and bank profitability. They also find a positive correlation between bank profitability and diversification, while bank concentration does not significantly impact on the profitability of banks. Finally, the authors also uncover a pro-cyclical link between bank profitability and lagged change in GDP.

Tregenna (2009) examines the structure and profitability of the US banking system, prior to the recent financial crisis, employing a dataset comprising US banks over the period 1994 to 2005. The author reports a strong correlation between bank profitability and market concentration.

Kanas et al. (2011) employ a semi-parametric empirical model in order to examine the profitability of US banks for the period 1988 to 2011. They report low profit persistence over this time period. Furthermore, they find evidence of a non-parametric relationship between profitability and the business cycle, short term interest rates, inflation expectations, credit risk and loan portfolio structure.

To summarise, the weight of evidence from the above literature suggests that bank profits do indeed exhibit persistent behaviour and typically more so than is found for industrial firms. Furthermore evidence suggests that persistence is typically found

to be stronger in larger banks and more diversified banks. Finally, persistence in developed countries is found to be greater than that reported for developing countries.

3.5.2. Alternative non-AR(1) Studies Examining the Persistence of Profit.

While most studies examining the persistence of profits adopt the AR(1) approach, several studies have either used alternative approaches or employed longer lags. This section considers a selection of such studies.

Gschwandtner (2010) examines the evolution of profit persistence in the US, by splitting the last half of the twentieth century into three sub-periods (1950-66, 1967-83 and 1984-99). This enables the examination of entry and exit by firms over the entire sample period, in contrast to most other studies which only analyse those firms which survive for the whole of the time period considered. The author estimates autoregressive processes up to order four, identifying the best lag model for further analysis. This is deemed to be the model with either the lowest Akaike Information Criteria (AIC) or Schwarz Bayesian Information Criteria (SBC) value. In addition, the author also estimates a state space model developed in Crespo-Cuaresma and Gschwandtner (2008), in order to allow for time variation in the persistence parameter. Overall, the results indicate that following the removal of barriers protecting the US economy from international competition throughout the 1960s to 1980s, a constant increase in competition subsequently ensued. A further example of a paper that used a higher order AR model is Glen et al. (2001). The study considers an AR(2) model in order to examine the persistence of profitability for 339 firms in seven emerging markets throughout the 1980s and early 1990s. The principal result uncovered by the

authors is that firms in advanced economies exhibit greater persistence than those in developing countries.

McMillan and Wohar (2010) use a threshold autoregressive model to test for asymmetry between above and below normal profits. Using data for UK firms, they find evidence for such asymmetry using both single-equation and panel techniques. In particular, they report that persistence is stronger for above average profit firms and suggest this may be due to higher barriers to entry for such firms.

Crespo-Cuaresma and Gschwandtner (2006) report lower levels of persistence, using a non-linear three-regime threshold model, than is typically found in linear studies. Gschwandtner and Hauser (2007) find evidence to support both long-range dependency and non-stationarity when analysing profit persistence using a fractional integration approach.

Cable and Jackson (2008) employ trend-based, structural time series analysis to a sample of 53 UK companies, and find evidence to support the cyclical behaviour of firms. That is, approximately one third of the firms considered appeared to have converged on the competitive norm over the sample period; while roughly 60% of the sample exhibited significant above or below norm long run persistence of profit. The authors found little evidence of firms in the process of convergence within the overall time frame, although for certain sub-periods, phases of convergence were observed.

Cable and Gschwandtner (2008) and Cable and Mueller (2008) undertake studies which not only seek to analyse convergence, but also depict the convergence profile. Both of these studies model the adjustment process by employing the standard

AR(1) framework, and subsequently employ structural time series analysis in order to estimate the underlying trend.

Ewing and Thompson (2007) examine the time series dynamics of corporate after-tax profits. They employ the Enders and Granger (1998) momentum threshold unit root test to consider the potential for asymmetric behaviour within profit persistence. Their results are supportive of such asymmetric behaviour; in particular, they report that corporate profit exhibits greater persistence when the rate of growth in profits is falling.

Kanas et al. (2011) employ a semi-parametric estimation technique to examine US bank profitability. Specifically, they implement the spline method of Keele (2008) and obtain the smoothing parameter using generalised cross validation. Their results indicate that US banks have a low degree of profit persistence.

Another aspect, considered by recent research, is concerned with the possibility that competitive conditions may be affected differently as a result of varying bank sizes. That is, small community banks which, in developed nations, tend to serve smaller, more localised customers have different competitive advantages than large banks. For example, these small banks are able to provide more retail-oriented rather than wholesale-oriented financial services (e.g., DeYoung, Hunter, and Udell 2004).

Further research examines the different technologies used by different sized banks to deliver their services, in order to ascertain how competitive conditions may be affected differently by varying bank size. Findings suggest that large banks may have a comparative advantage in lending technologies that are based on ‘hard’ quantitative data, such as credit scoring. On the other-hand, small banks may have a comparative

advantage in lending technologies such as relationship lending that are based on ‘soft’ information that is difficult to quantify and transmit through the communication channels of large banking organisations (e.g., Stein, 2002) and may create agency problems that require a closely held organisational structure (e.g., Berger and Udell, 2002). In support of these arguments, large banks relative to small banks in the U.S. have been found to lend proportionately less of their assets to SMEs (e.g., Berger, Kashyap, and Scalise, 1995), to lend to larger, older, more financially secure SMEs when they do so (e.g. Haynes, Ou, and Berney, 1999), to charge lower rates, to earn lower yields, and require collateral less often on their SME loans (e.g., Berger and Udell, 1996; Carter, McNulty, and Verbrugge, 2004), to have shorter and less exclusive relationships (e.g., Berger and Udell, 2002), and to base their lending decisions more on financial ratios than on prior relationships (e.g., Cole, Goldberg, and White, 1999). Thus, the literature is strongly consistent with the hypothesis that large banks tend to make hard-information-based transaction loans to larger, safer, more transparent borrowers, while small banks tend to make more soft-information-based relationship loans to smaller, riskier, more opaque borrowers.

3.6. Time-variation in the persistence of profits.

As noted in the Introduction there has been relatively little work examining time-variation in the persistence of firm profits. Arguably this arises due to the relatively short time series available. Nonetheless, there have been several papers that have directly or indirectly considered possible time-variation.

Crespo Cuaresma and Gschwandtner (2013) examine the determinants of profit persistence using a model that allows for time variation within the persistence parameter and which explicit links persistence to firm and industry factors. Thus, while previous studies which examine the impact of industry and firm characteristics estimate only one measure of profit persistence for the entire time span for each company or industry considered, in this study the authors allow the profit persistence variable to vary with time. In addition, the authors seek to analyse the effects of both industry and firm characteristics on profit persistence.

As discussed in Chapter 4, studies which examine the persistence of profits typically specify the dynamics of company profits as a first order autoregressive process, given by the following equation:

$$\pi_{i,t} = \alpha_i + \lambda_i \pi_{i,t-1} + \varepsilon_{i,t} \quad (3.3)$$

where λ_i is the short run persistence parameter, and $\varepsilon_{i,t}$ is a white noise disturbance term. The long run projected profit rate for firm i is given by $\pi_i^* = \alpha_i / (1 - \lambda_i)$. Under the hypothesis of perfect competition, the long run projected profit rates would be zero, however as many empirical studies have shown, there appears to be significant differences in π_i^* across firms. In this study, Cuaresma and Gschwandtner seek to empirically assess the potential determinants of the differences in both short and long run persistence (given by λ_i and π_i^* respectively). The authors propose a simple generalisation of equation (3.3) where α_i and λ_i are assumed to be functions of a set of economic variables $X_{i,t}$ and $Z_{i,t}$ respectively, such that:

$$\pi_{i,t} = \alpha(X_{i,t}) + \lambda(Z_{i,t})\pi_{i,t-1} + \varepsilon_{i,t} \quad (3.4)$$

Estimating equation (3.4) therefore allows us to examine both the impact of changes in the variables on short-run persistence, by studying the effects of changes in $Z_{i,t}$ on $\lambda(Z_{i,t})$; and the impact of changes in the variables on long-run persistence, by analysing $\alpha(X_{i,t}/[1-\lambda(Z_{i,t})])$.

The authors estimate this equation using profit data and both industry and firm characteristics for 156 US companies over the time period 1950 to 1999. Equation (3.5) below shows this econometric specification, in which it is assumed that the $\alpha(\cdot)$ and $\lambda(\cdot)$ functions are linear on $X_{i,t}$ and $Z_{i,t}$ respectively.

$$\pi_{i,t} = \alpha_0 + \sum_{i=1}^{\bar{x}} \alpha_i x_{i,t} + (\lambda_0 + \sum_{i=1}^{\bar{z}} \lambda_i z_{i,t}) \pi_{i,t-1} + \varepsilon_{i,t} \quad (3.5)$$

The authors use the following firm characteristics to explain profit persistence: market share (MS), the volatility of the profit rate (RISK), the size of the company (as measured by the value of assets, ASSETS) and the growth rate of the company's sales (GRSALES). The industry characteristics used are concentration (in this case the percentage of industry output produced by the 4 largest firms in the industry, CR4), size (the number of firms in the industry, NFIRM, and the value of shipments, VS) and finally the growth of the number of firms.

The authors find evidence to suggest that, in terms of industry characteristics, both concentration and industry size have a significant effect on profit persistence. In support of the Chamberlinian hypothesis, the results obtained predict that relatively small and concentrated industries will display greater profit persistence. Examining the firm level characteristics, the authors report that proxies for market share, firm growth, firm size and profit volatility all appear to be significant determinants of short and long run profit persistence.

Crespo Cuaresma and Gschwandtner (2006) use a dataset comprising of profits for more than 150 US companies over a 50 year time span in order to test the widely researched competitive environment hypothesis, which states that in the long run the competitive process will eliminate any economic profits or losses. The main conclusion from this body of literature is that deviations from the norm tend to be very persistent. Furthermore, the empirical literature examining the competitive environment hypothesis typically reports evidence of nonstationary (unit root) behaviour of company profits. Profit time series data is frequently modelled using a simple threshold autoregressive model that allows for nonstationary behaviour over subsamples. However, it is also well known that univariate methods for testing unit roots have low power, especially for relatively small sample sizes, thus consequently several different Dickey-Fuller (DF) type tests have been proposed in order to improve the power of unit root testing. In this paper, the authors employ an alternative non-linear modelling strategy for company profits, which allows for a ‘band of inactivity’ (as opposed to nonstationary behaviour in some cross sections) in which profits may present nonstationary behaviour. The model employed is a simple TAR (threshold autoregression) model, (with the inclusion of an inaction band where the profit rate is allowed to behave in a nonstationary fashion), which allows for testing against pure unit root processes using methodology developed by Caner and Hansen (2001). The authors report statistical evidence of non-linear adjustment for a large proportion of firms where the null hypothesis of a unit root cannot be rejected using the DF test. Furthermore, they report that when the existence of non-linearities is not taken into consideration, the persistence of profits is over estimated. That is, when inaction bands are taken into account, the

overall evidence on the level of persistence of profits in US companies changes significantly.

In application of the non-linear model, Cuaresma and Gschwandtner (2006) impose symmetry. That is, while they allow for an inner random walk regime, the regimes governing mean reversion (the opposite to persistence) have a common coefficient. Thus, whether profits are currently above or below normal, the strength of persistence (or speed of reversion) is equal. This implicitly assumes the strength of competitive pressures are equal regardless of whether entry or exit pressures are more prominent. In contrast, McMillan and Wohar (2011) employ an asymmetric autoregressive model, using a dataset comprising of 57 UK firms over the period 1980 to 2007, in order to examine profit persistence. This model allows the parameter governing persistence to vary between positive and negative profits relative to normal profits, therefore enabling the authors to differentiate between entry and exit as conduits of the competitive model. This also allows testing of whether profits persistence is equal irrespective of whether a given firm is faced with potential exit or the threat of entry by competitor firms. Hence, the authors seek to determine whether the threat of entry or exit has a greater influence on restoring the competitive equilibrium. The results from this paper suggest asymmetric behaviour in the profits persistence parameter, such that persistence is stronger when profits are above normal. This result is robust to both estimates on individual firms and two panel model specifications. The results imply that the competitive pressures surrounding profitable firms, notably entry, are weaker than those surrounding less profitable firms, notably exit.

Gschwandtner (2012) uses the standard persistence of profits AR(1) equation but splits the full sample (1950-1999) in to three sub-samples (1950-66, 1967-1983,

1984-1999). Further, the firms that appear in each sample are the ones that were alive in the respective sub-sample. Thus, this implicitly allows for firms to enter and exit. Gschwandtner (2012) estimates the AR(1) persistence parameter for each firm in each sub-sample and reports that the average value has declined from 0.49 to 0.42 to 0.36 through the three sub-samples respectively. This indicates that competitive pressures in the US have increased over time, which Gschwandtner attributes to changes in firm and industry size, industry growth, and more latterly, risk and advertising.

The literature examining time-variation within profit persistence is very much in its infancy. There is a generally accepted view that a constant degree of persistence, especially when measured over a time series of twenty years, is an unrealistic one. Persistence will change as competitive pressures change due to market evolution (such as in the Schumpeterian view of creative destruction) or due to regulatory change. As such, the above work has largely focused on documenting such changes through a variety of empirical techniques. That is, using sub-sample analysis, Kalman filter techniques, threshold regressions and variable interaction regressions, the above work has documented differences in persistence over time. The above work has focussed on manufacturing firms, thus, this thesis seeks extends that analysis and fills an obvious gap in the literature by considering time-variation in banks. Furthermore, given both regulatory change and innovation over the past 25 years or so, we would perhaps expect such time-variation to exist.

3.7. Competition and Fragility.

The literature on classical financial structure states that highly leveraged firms, such as banks, have an incentive to engage in risky behaviour. That is, shareholders benefit if the gamble works; whereas lenders, not the bank, bear the cost if it does not (Jensen and Meckling, 1976). The charter-value argument presents the view that for large banks, with market power, the incentive exists to maximise risk-taking behaviour. The screening theories present the view that these banks also have incentive to improve the quality of their assets. That is, allocative efficiency can improve the quality of a bank's loan portfolio in that banks with market power may have a greater incentive to screen loans. Both sets of theories argue that competition is bad for an economy.

Keeley (1990) argues that an increase in competition in the banking industry contributed to the rise in bank failures in the U.S. during the 1980s. Numerous authors, for example Besanko and Thakor (1993) and Perotti and Suarez (2002), have expanded the literature, modelling different factors that affect charter value. Hellman, Murdock and Stiglitz (2000) examine charter value in an environment that has capital regulation and find that this promotes risk-taking behaviour. Repullo (2003) models competition in the deposit market and finds that a very competitive market, without capital requirements, promotes risk-taking behaviour by banks. Keeley (1990) and Demsetz, Saidenberg and Strahan (1996), report that an increase in competition leads to a decrease in charter value, which may lead to an increase in bank risk. Allen and Gale (2000) find that an increase in competition leads to an increase in contagion (defined as the risk that a credit or liquidity shock to one financial system participant leads to substantial shocks to other participants). Shaffer (1998) argues that an increase in competition may result in the deterioration of a bank's lending portfolio through a

higher number of low-quality loans. Cordella and Yeyati (2002) find that competition leads banks to reduce their investment in monitoring. Salas and Saurina (2002) conclude that higher charter values are associated with lower levels of credit risk. De Nicolo (2000) finds that an increase in bank size is associated with a lower charter value and higher insolvency risk. Beck, Demirgüç-Kunt, and Levine (2003) conclude that both concentration and competition increase financial stability.

Most of the literature on the relationship between competition and risk seeks to analyse the impact that competition has on banks' incentives to undertake risk. There are two broad approaches, namely theoretical studies versus empirical studies. The theoretical literature can be broadly divided into two opposing views which derive different predictions concerning the nature of the relationship between concentration, competition and bank risk. Following on from this, the theoretical literature is presented under two sections according to whether the model predicts a negative relationship between the variables (competition-stability hypothesis), or whether the model predicts a positive relationship between the variables (competition-fragility hypothesis). The empirical literature is also presented under two sections; namely bank-level studies which focus on one country, versus empirical studies which examine cross-country data. Bank-level studies produce ambiguous results concerning the relationship between competition and risk, while cross-country studies mostly uncover a positive relationship between the variables.

3.7.1. Theoretical Literature.

As noted above, theoretical models offer contrasting predictions regarding the relationship between concentration, competition and stability. The following two subsections divide the literature according to whether the models employed predict a positive or negative relationship between competition and stability.

3.7.1.1. Competition-fragility hypotheses.

Firstly considering the literature which assumes a positive relationship between competition and stability, the traditional competition-fragility hypotheses predict that more concentrated and less competitive banking systems (with restricted entry), are more stable. It is assumed that less competition allows banks to earn abnormal positive profits, which then act as a barrier against fragility, and furthermore provide incentives against excessive risk taking. Conversely, more competition erodes market power, decreases profit margins and results in reduced franchise value. This therefore encourages banks to undertake greater risks in order to increase returns (e.g. Marcus 1984, Keeley 1990, Demsetz, Saidenberg and Strahan 1996, Carletti and Hartmann 2003). Known as the “charter value” view of banking, various authors including Marcus (1984), Chan, Greenbaum and Thakor (1986), and Keeley (1990) have modelled this approach, in which it is assumed that banks are able to choose the risk of their asset portfolio. However, where there is limited liability, bank owners face incentives to shift risk to depositors as they face no negative consequences as a result of engaging in risk taking behaviour. In more competitive banking systems in which individual banks earn lower profits however, there is a much greater incentive for banks

to undertake more excessive risks, thereby resulting in a banking system that is more fragile. Furthermore, in more competitive systems there is less incentive for banks to screen borrowers properly, as they earn fewer informational rents from their relationship with borrowers. As Boot and Greenbaum (1993); and Allen and Gale (2000, 2004) report, this increases the risk of fragility. These models predict that as a result of the widespread deregulation in the US throughout the 1980s and 1990s, in which many barriers to competition were removed, the banking industry would become more fragile as a result of increased levels of competition.

A number of studies have examined the impact of regulatory policies on stability within the banking sector, seeking to identify those policies which enhance banks' charter value and consequently reduce risk-taking. For instance, Diamond and Dybvig (1983) argue that deposit insurance can reduce fragility by preventing bank runs, but also introduces moral hazard and risk shifting into the banking system. That is, banks may be encouraged to engage in excessive risk-taking behaviour, while at the same time market participants have less incentive to monitor bank behaviour. Therefore, any regulatory policy that legislates for more generous deposit insurance designed to instil confidence in the banking system and thus prevent bank runs, may actually undermine bank stability if incumbents are encouraged to take excessive risks. Matutes and Vives (1996) employ a multiple equilibrium model and report that a systemic confidence crisis may be averted under a system in which there are deposit insurance schemes. While deposit insurance schemes can enhance stability in the banking sector, there is also evidence that such legislative policy may increase unhealthy competition between banks, reduce diversification benefits and subsequently increase the likelihood of bank failure with potentially catastrophic consequences for the entire the banking system.

Cordella and Yeyati (2002) for instance, show that higher levels of competition arising in systems with fixed-rate deposit insurance schemes, increases both interest rates on deposits and risk, while also reducing profits. On the other hand, competitive environments in which deposit insurance schemes are risk-adjusted enable banks to commit to lower asset risk, thus lowering the cost of funding. For example, Perrotti and Suarez (2002) report that policies which aim to merge failing banks with healthy banks encourage banks to act more cautiously regarding the risks they take; as, by definition, the last remaining bank following a period of failed bank merger activity, would increase its charter value. Alongside this, policies which encourage new bank entry into the system may curb the negative effects associated with an increase in concentration resulting from merger activity.

Another argument put forward by numerous authors with regard to the competition-fragility hypothesis, is that banking systems which are more concentrated produce banks which are larger and therefore better able to diversify their portfolios. Diamond (1984), Ramakrishnan and Thakor (1984), Boyd and Prescott (1986), Williamson (1986) and Allen (1990), among others, argue that economies of scale are present in banking. Thus, as size increases and larger banks reap economies of scale, the banking industry should experience more stability as banks' risk is spread out throughout a more diversified portfolio.

A final argument of this hypothesis focuses on the number of banks that regulators must supervise. If a more concentrated banking system produces a smaller number (of large) banks, this may give rise to a more stable banking industry as regulators have fewer banks to oversee. Allen and Gale (2000), report that the competition-fragility hypothesis is evident in the US. Here the banking industry is

characterised by a large number of banks and has historically been more susceptible to financial instability than for instance the UK or Canada, where fewer large banks dominate the banking sector.

3.7.1.2. Competition-stability hypotheses.

This sub-section presents the literature which assumes a negative relationship between competition and stability, namely the charter-value hypothesis. As mentioned in the previous section, these studies argue that more concentrated and less competitive banking systems are more stable. In contrast to this, a number of authors have argued that banking systems which are more concentrated and less competitive actually result in increased bank fragility. Boyd and De Nicolo (2005) for instance, adopt a different view to the standard argument that banks which hold some degree of market power (arising in concentrated systems) earn larger profits which therefore leads to greater stability (as there is no need for such banks to undertake greater risks in order to increase their profits). The authors argue that this approach does not consider the potential impact of banks' market power on firm behaviour. That is, the riskiness of banks' assets is not determined by banks themselves, but rather by those who borrow from banks, as they choose the riskiness of the investment undertaken with bank loans. The authors find that banks' market power is indeed greater in more concentrated systems, thereby enabling them to charge a higher rate of interest on loans. Higher interest rates make it harder for firms to repay loans and may encourage firms to undertake greater risks, which in turn increases the likelihood of defaulting on loans. The higher interest rate may also result in a riskier set of borrowers as a result of

adverse selection considerations. The authors therefore find a positive relationship between concentration and bank fragility, for many parameterisations of the model, and thus the probability of systemic distress. Caminal and Matutes (2002) also report that banking systems which are less competitive can lead to less credit rationing, bigger loans and an increased probability of failure.

Compared to less concentrated banking systems, more concentrated systems are typically characterised by fewer banks, thus making the potential for bank failure among concentrated systems more of a concern to policymakers, according to advocates of the competition-stability view. Numerous authors, for example Mishkin (1999), have therefore argued that banks in more concentrated systems typically receive larger subsidies through implicit “too-big-to-fail” policies which may consequently encourage risk-taking behaviour, thereby increasing fragility within the banking sector. Furthermore, the risk of contagion is more pronounced in more concentrated banking systems with larger banks, therefore producing a positive correlation between concentration and bank fragility.

Advocates of the competition-stability view argue that there is a positive correlation between bank size and complexity, such that larger banks are harder to monitor than small banks, therefore making more concentrated banking systems more difficult for authorities to regulate. Recent consolidation has further compounded the problem facing bank supervisors, as the emergence of financial conglomerates offering a range of financial services previously offered by specialised institutions, has increased the complexity of these financial institutions. This argument therefore predicts a positive relationship between concentration and fragility.

3.7.2. Empirical Literature.

The following section presents an overview of the empirical studies which seek to examine the relationship between market structure, competition and stability. Again, the literature is divided into two sections, namely the more traditional studies which sought to examine bank-level data focused only on one country or the comparison of two countries; versus the more recent studies which employ cross-country, time-series data sets.

3.7.2.1. Bank Level Evidence.

In a seminal paper, Keeley (1990) examines the relationship between competition and risk following the relaxation of state branching restrictions during the 1980s. The author uncovers evidence that competition increased following deregulation, which reduced banks' capital reserves and increased risk premiums (as shown by higher interest rates on certificates of deposit). This may therefore imply that increased competition amongst banks in the US, following deregulation during the 1980s, eroded charter values and increased bank fragility throughout this period. Similarly, Dick (2006) uncovers evidence that following deregulation during the 1990s, both charge-off losses and loan loss provisions increased. However, in contrast, Jayaratne and Strahan (1998) report a sharp decline in loan losses following branch deregulation.

Hellman, Murdock and Stiglitz (2000), argue that removing interest ceilings on deposits, in order to promote competition, erodes franchise value and therefore as a result encourages excessive risk taking behaviour by banks. Jiménez, Lopez and Saurina (2007), construct a dataset of Spanish banks for the period 1988 to 2003. Using

the Lerner Index to measure market power, the authors find evidence to suggest that banks with more market power have lower non-performing loans. These findings thus lend support to the charter value hypothesis. However, the authors uncover no evidence of a significant relationship between market structure, measured by concentration ratios, and non-performing loan ratios.

Numerous studies have also undertaken extensive research into the effect of market structure and competition on bank fragility. These studies examine the impact on concentration, of the creation of larger banks via merger activity. Paroush (1995) reports that bank stability increases following merger activity, as the resultant diversification gains lead to an increase in banks' market power. Benston, Hunter and Wall (1995) and Craig and Santos (1997) also support this view. Following bank mergers in the US, these authors also indicate diversification gains leading to greater bank stability. In contrast however, empirical work by Chong (1991) and Hughes and Mester (1998), finds that the riskiness of bank portfolios increases following bank consolidation.

A few authors have undertaken descriptive studies using data from two countries to compare banking market structures and stability. For instance, Bordo, Redish and Rockoff (1996) compare Canadian and US banking systems, and uncover a greater degree of stability in the former. The authors relate this to the fact that Canadian banking is defined by an oligopolistic market structure, while the US banking market has a higher degree of competition. However, although Canadian banks have higher levels of profitability, this is not necessarily indicative of less competition in the Canadian banking system. Hoggarth, Milne and Wood (1998) report more competition and less stability in the UK banking system compared to the German banking system.

Finally, comparing the Spanish and Greek banking systems, Staikouras and Wood (2000) report both greater competition and more stability in Spain.

Reviewing the conclusions from the numerous bank-level empirical studies presented above, it is apparent that there exists no overwhelming evidence which would support adopting the competition-stability hypothesis in favour of the competition-fragility hypothesis, or vice versa. However, the findings do enable two conclusions to be drawn. First, a higher degree of market concentration does not necessarily indicate less competition. Second, there is an important interaction effect between the regulatory and supervisory framework on the one hand, and market structure and competitiveness on the other hand, in their impact on the stability of the banking system (as predicted also by several theoretical theories).

3.7.2.2. Cross-Country Studies.

In more recent years, large cross-country time-series datasets have become available, subsequently instigating a number of studies that seek to test the validity of the different theoretical models.

Schaeck and Cihak (2007) examine data for 2600 European banks, and report that in more competitive environments, banks have higher capital ratios. Thus, they argue that bank capitalisation is one of the channels through which competition fosters stability.

The cross-country evidence mostly indicates a positive relationship between bank competition and stability, but produces mixed results regarding the relationship

between bank concentration and stability. Again, this highlights the shortcomings of market structure measures of bank competition such as concentration ratios. Thus, more concentration may improve stability, but this may be through other channels such as improved risk diversification, rather than due to the assumed lack of competitiveness. Whilst the cross-country studies present a mostly consistent conclusion, evidence from country-specific bank-level studies presents much more ambiguous findings. This can be explained by the fact that bank-level studies do not control for the regulatory framework.

Berger et al. (2009) test the impact of market structure on the risk potential of banks using firm-level data for 8235 banks from 23 industrialised countries for the time period 1999 to 2005. The authors employ GMM techniques for a number of regressions measuring market power, using three different indicators of risk as the dependent variable in order to proxy for financial stability, whilst controlling for a number of other variables. These indicators are first, the ratio of non-performing loans to total loans (as a proxy for loan portfolio risk); second, the Z-index (which provides an inverse measure of overall bank risk) and third, the ratio of equity to total assets (which indicates a bank's level of capitalisation). The authors argue that the competition-stability and competition-fragility theories need not necessarily yield opposing predictions on the effects of competition and market power on bank stability. Thus, banks that are deemed to be risky in one area of their business, may potentially off-set this risk in another portfolio area, thereby maintaining a lower overall level of risk. The results of the study find that banks with a higher degree of market power tend to have less overall risk (consistent with the competition-fragility approach). The authors also find that market

power increases loan portfolio risk (which may be partly offset by higher equity capital ratios); evidence that lends some support to the competition-stability view.

Liu et al. (2012) also examine the impact of competition on bank risk-taking behaviour in four South East Asian countries. The authors report that banks do not increase their risk-taking behaviour as a result of competition. Furthermore, they find that concentration is inversely related to bank risk, while there is a positive relationship between regulatory restrictions and risk-taking behaviour by banks.

Liu et al. (2013) undertake an empirical analysis of competition and bank stability for 10 European countries over the period 2000 to 2008, with a focus on regional bank competition analysis rather than the traditional national measures of competition and macroeconomic activity used to examine performance and risk features across banks. The authors specify a dynamic panel regression model, the purpose of which is to capture region-specific competition and economic conditions on bank stability. Also included are a number of bank specific covariates used to examine the drivers of bank stability. Several model specifications are estimated in order to assess the impact of regional bank competition and economic conditions on bank stability. Overall the authors report that there exists a non-linear relationship between bank competition and stability. In relatively uncompetitive markets increased competition appears to improve stability, conversely it increases fragility in markets which are relatively uncompetitive. In addition, the authors report that the stability of banks is significantly influenced by regional economic conditions such as unemployment.

Beck et al. (2013) also examine cross-country variation in the relationship between bank competition and bank stability. The authors explore market, regulatory

and institutional features in order to explain the large variations in this relationship across the different countries considered. The authors estimate a dynamic panel regression of risk on competition (as proxied by the Lerner Index) and bank specific factors. They report that an increase in competition will have a greater impact on banks' fragility in those countries that are characterised by stricter activity restrictions, lower systemic fragility, better developed stock exchanges, more generous deposit insurance and more effective systems of credit information sharing.

3.8. Conclusion.

The purpose of this chapter is to provide a review of the literature regarding competition in banking. Understanding competition is important because it is argued that on the one hand it encourages greater efficiency, which is an important factor in determining economic growth; however, on the other hand it can be argued that too much competition may lead to greater instability in the banking sector. Following deregulation, the competitive environment within which banks operate has changed significantly, meriting closer examination. Furthermore, the subsequent impact on both bank strategy and performance is also of significant interest due to any potential implications for future regulatory and supervisory policy.

The literature is presented in three sections; namely SCP in Banking, New Empirical Industrial Organisation and Other Approaches. Those studies which adopt the Structure Conduct Performance (SCP) approach, seek to determine the extent of competition within a given market structure based on the assumption that there exists a link between market structure and the conduct and performance of firms and industries.

Under this approach it is argued that greater industry concentration, resulting in increased individual market power of large banks, is more likely to lead to anti-competitive behavior by banks.

The Chicago/ Revisionist critique was subsequently developed in the 1970s, in response to the recognised shortcomings of the SCP approach. At the centre of this critique is the efficiency hypothesis which argues that large banks make high profits because they are more efficient. Therefore, high concentration and subsequent high prices or profits is a reflection of more efficient performance by banks, rather than an indication of more effective collusion within the markets. As such, a highly efficient bank may earn greater profits as a result of its ability to better maximise returns.

In response to shortcomings of the SCP and Efficiency Hypothesis paradigms, the New Empirical Industrial Organisation (NEIO) approach was developed. With a focus on bank level rather than industry level conduct/strategy, NEIO studies seek to examine the response of prices (and in some instances quantities) to changes in competitive conditions. Thus, the extent of competition or collusion within a market can be inferred by examining the behaviour of incumbent banks. The two main empirical techniques used to test bank conduct directly are the Panzar-Rosse (PR) and Bresnahan-Lau (BL) approaches.

More recently, other approaches which seek to examine competition in banking by employing various different models have also been developed. These include models to test for price-taking versus price-setting behaviour and demand models based on consumer choice under product differentiation. Models that account for the fact that competitive conditions may be affected differently by varying bank size and varying

available technologies are also considered. Most recently, a number of studies have examined the role of endogenous fixed cost investments on equilibrium industry structure. These endogenous fixed cost investments are an indication of the effectiveness of barriers to entry and thus the level of competition within an industry. While it is widely argued that competition in banking is beneficial to consumers, overall, there is less consensus within the literature with regard to the preferred degree of competition.

Also presented in this chapter is a review of the literature which examines the relationship between competition and fragility. The literature on classical financial structure states that banks have an incentive to engage in risky behaviour. The charter-value argument presents the view that for large banks, with market power, the incentive exists to maximise risk-taking behaviour. The screening theories present the view that these banks also have incentive to improve the quality of their assets. Both theories argue that competition is bad for an economy.

Most of the literature on the relationship between competition and risk can be divided into two broad approaches namely theoretical studies versus empirical studies; both seek to analyse the impact that competition has on banks' incentives to undertake risk. The theoretical literature is also broadly divided into two opposing views; the competition-stability hypothesis (which predicts a negative relationship between concentration competition and bank risk) and the competition-fragility hypothesis which predicts a positive relationship. The empirical evidence is inconclusive with regard to which hypothesis is more dominant. The empirical literature is also presented under two sections; namely bank-level studies which focus on one country, versus empirical studies which examine cross-country data. Bank-level studies produce ambiguous

results concerning the relationship between competition and risk, while cross-country studies mostly uncover a positive relationship between the variables.

Chapter 4. De-Regulation and the Persistence of Profit of US Banks.

4.1. Introduction.

Examining the dynamics of profit and profits persistence is important in understanding the competitive process and the effects of regulatory change and economic upheaval on profit and profit persistence. This, in turn, has implications for the conduct and effectiveness of competition policy and in particular, whether policies designed to increase competition reduce persistence and thus restore the competitive equilibrium position. Key examples of studies which examine profit persistence within the banking industry include Levonian (1993), Roland (1997) and Berger et al (2000) for the US and Goddard et al (2004a, 2004b, 2011) for Europe.

Structural and conduct deregulation and prudential regulation along with technological and financial innovation as well as changes in the economic environment have transformed the banking industry. In the US, geographic and product market regulations historically constrained the activity of commercial banks. Over the past two decades, however, financial deregulation (which aims to increase competition) eased several previous constraints. For example, the McFadden Act of 1927, which prohibited interstate branch banking, was repealed by the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994; while the Glass-Steagall Act of 1933, which prohibited commercial banks from transacting other financial services including investment banking and insurance, was repealed by the Gramm-Leach-Bliley Financial Services Modernization Act of 1999. This series of deregulatory steps increased competition as barriers to entry in many markets were reduced or eliminated. New strategic opportunities for enhanced profitability were also created for established

banks, which many realized by geographic and product diversification. The net effect of such changes on competition and the profitability of incumbent banks is unclear.

This chapter seeks to understand the degree of profits persistence in US commercial banks and the effects on persistence of regulatory changes largely designed to increase competition and thus, lower persistence. Furthermore, we provide a preliminary look at the effects of the liquidity crisis that began in 2007 on persistence. Therefore, this chapter examines the evolution of US bank profitability pre- and post-the introduction of Riegle-Neal Interstate Banking and Branching Efficiency Act and the Gramm-Leach-Bliley Financial Services Modernization Act. Specifically, it uses econometric models to assess the extent to which entry and exit are sufficiently free to eliminate any abnormal profit quickly so that all bank profit rates tend to converge towards a long-run average value. The alternative is that some incumbent banks may have the capability to prevent imitation, or retard or block entry. If so, abnormal profit tends to persist from year to year, and differences in bank-level long-run average profit rates may be sustained indefinitely. The degree of first-order serial correlation in profit data provides an indication of the speed at which competition causes above- or below-average profits in one year to converge subsequently towards long-run equilibrium values. This chapter contributes to the existing literature by not only examining a larger dataset than previously considered, both in the time and cross-sectional dimension, but furthermore, explicitly incorporating key changes in the modelling allows us to comment on the effectiveness of the legislation.

This chapter therefore uses a panel model approach to examine the determinants of US commercial bank profits using various bank and industry variables as well as a persistence parameter over the period 1984 to 2009. Of particular interest, this chapter

examines how persistence has changed following two major pieces of regulatory change in the US banking sector, namely the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act and the 1999 Gramm-Leach-Bliley Act, using indicator variables. Both Acts can be seen as enhancing competition within the banking sector through, in the former case, allowing cross-state merger activity and, in the latter case, through allowing banks to diversify into other activities, such as insurance and investment banking. As such, we may expect to see the effect of each Act in changing (reducing) the strength of any profits persistence. In summary of the results, this chapter reports the following key findings. First, the general level of persistence in profit is relatively low, more so than that reported for manufacturing firms and as previously reported for US banks by Goddard et al. (2011). Second, the degree of profit persistence fell following the passage of the Interstate Banking Act of 1994. This may indicate an increase in competition arising from cross-state activity. Third, profit persistence increases following the 1999 Gramm-Leach-Bliley Act, which allowed banks to diversify into non-traditional banking activities. This Act allowed banks to generate income from alternative sources and hence diversify their activities, thus does not necessarily imply that the Act served to reduce competition. Finally, persistence declined following the financial crisis that began in 2007 when banking industry profits fell.

The persistence of profits approach largely dates back to Mueller (1977, 1986) and was subsequently extended by Geroski and Jacquemin (1988) and Geroski (1990). This early work employed a first order autoregressive model to measure the degree of profit persistence, demonstrating the existence of non-zero persistence measures which are inconsistent with the competitive equilibrium model. From this early work

developed the persistence of profits literature as it has come to be known, with a number of authors uncovering evidence of profit persistence. For example Mueller (1990) concludes that profits persist in a range of West European and North American economies. Maruyama and Odagiri (2002) likewise conclude that profit persistence is too high in a selection of Japanese firms. Similarly, Gschwandtner (2005) reports that profits persist for a period of over fifty years in US firm data. While this literature largely refers to industrial firms, recent literature specifically examining banks includes Claessens and Laeven (2004), Goddard and Wilson (2009), Goddard et al, (2010, 2011) and Wilson and Liu (2010). These studies find evidence of bank profit persistence across a range of countries.

The remainder of this chapter is structured as follows. Section 4.2 presents a review of the literature which seeks to examine the persistence of profit. This includes an overview of those studies which analyse profit persistence in manufacturing, at both the firm and industry level, as well as the more recent research which specifically examines persistence of profit in the banking industry. Section 4.3 introduces the empirical methodology used to test for the persistence of bank profits. This includes a discussion of both the fixed effects panel method and the dynamic panel approaches of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). This section also includes a brief rationale for the choice of model and motivates the choice of variables for inclusion in the empirical exercise. Data and empirical results are presented in Section 4.4. This includes summary information for the data and the results of estimating the different empirical specifications of the model. Finally, Section 4.5 summarises and concludes the results.

4.2. Literature.

As previously mentioned, the persistence of profit (POP) strand of literature emerged in the 1970s as a revisionist critique of the prevailing structure, conduct, performance (SCP) paradigm put forward by Bain (1956). Mueller's seminal contributions (1977, 1986) paved the way for a body of literature which sought to examine whether company profits converge to a single mean value over time in order to test the competitive environment hypothesis. The stochastic time series model developed by Mueller (1986) and subsequently extended by Geroski and Jacquemin (1988) and Geroski (1990) provided the basis for much of the POP literature. Most commonly, studies employ an AR(1) specification model to measure POP and typically report large measures of profit persistence which differ from the competitive equilibrium of normal profits. A full literature review of the POP approach is presented in Section 3.6.

4.3. Hypotheses and Empirical Methodology.

The following section discusses the model used to test for the persistence of bank profits, whilst accounting for the effects of bank-specific, industry-specific and macroeconomic factors on bank profitability. As Berger et al (2000) argue, impediments to market competition, informational opacity and/or sensitivity to regional/macroeconomic shocks are all factors that enable abnormal bank profits to persist over time, rather than revert to their mean values from one time period to the next. As such, the model employed here is dynamic in nature, via the inclusion of a lagged dependent variable among the regressors. Furthermore, a range of variables widely used in previous empirical studies that examine bank profitability, are also included. As noted above, of particular interest is the degree of profit persistence and

whether that changes following de-regulation designed to increase competition. These variables are discussed below.

The model is specified as:

$$\pi_{it} = \alpha + \gamma_i + D_t + \lambda\pi_{i,t-1} + D_t \lambda\pi_{i,t-1} + \beta_1 X_{it} + \beta_2 M_t + u_{it} \quad i = 1 \dots N; t = 1 \dots T \quad (4.1)$$

Where π_{it} is the profitability of bank i at time t and $\pi_{i,t-1}$ is lagged profitability. X_{it} is a vector of exogenous bank-specific regressors and M_t is a vector of industry and economic-specific variables. The common constant for all observations is denoted by α . This model allows for individual bank-specific (fixed) effects captured by the dummy variable γ_i . u_{it} is a random disturbance coefficient. In the above equation, the dependent variable is expressed as a deviation from the sample mean at time t . The rationale for the fixed effects model is as follows. Under the null hypothesis that all slope coefficients equal zero (i.e. λ, β_1 and $\beta_2 = 0$) the model would therefore imply that all banks have a common profit level given by α . Clearly all banks across the sample do not have a common profit level, thus this does not make sense. In view of this, the model used allows for fixed effects (represented by the term γ_i) which allows for the bank-specific effects.

The dependent variable is a commonly used measure of profitability, return on assets (ROA), measured as net income over total assets. The profit rate of bank i at time t ($\pi_{i,t}$) is measured as the relative deviation from the sample mean at time t . Therefore, the parameter λ is a measure of the speed at which short-run profit reverts towards long-run values. That is, it is a measure of the speed of profit convergence. The parameter λ captures the scope of any persistence in short run profits from one time period to the

next. It is thus a measure of the speed of adjustment at which short run values converge towards long run profit levels, and as such provides an estimate of the extent to which entry and exit mechanisms are effective in dissipating below or above average levels of profitability. A value of λ close to zero indicates that the degree of profits persistence is small and therefore abnormal profits revert to their mean values quickly. This is typically interpreted as a sign of increased competition.

Regulatory Dummies

Regulatory changes have affected the competitive environment within which banks operate. These changes are introduced into the model using indicator variables. We create a dummy variable equal to one for the period after the enactment of the Riegle-Neal Interstate Banking and Branching Efficiency Act in 1994, and zero otherwise. For the Gramm-Leach-Bliley Financial Services Modernization Act of 1999 we create a second dummy variable which is equal to one after 1999 and zero otherwise.

In addition to the changes in the competitive environment resulting from deregulation in the 1990s, banks have also faced significant challenges from the recent financial crisis. It is thus of interest to investigate how the recent financial crisis and its aftermath affected bank profitability. To this end an indicator variable that takes a value of one for the years 2007 to 2009 and zero otherwise is included in the estimable model.

The speed at which short-run excess profits are eliminated is also likely to be affected by changes in regulation and the recent financial crisis. We introduce multiplicative interaction terms between the lagged profitability measure (ROA) and the dummy variable in order to capture the impact of regulatory change and recent financial crisis on profit persistence.

Bank-Specific Regressors

This section begins by listing the choice of regressors, and then provides a brief rationale for their inclusion. The choice of bank specific (X_{it}) variables closely follows those used elsewhere in the literature. See for example Liu and Wilson (2010), Tregenna (2009) and Goddard et al (2010).

X_{it} denotes a vector of exogenous bank-specific regressors comprising the following. Non-interest income divided by total operating income, used as a proxy for diversification (DIV). Loans divided by total assets, which is a proxy for liquidity (LA) while equity divided by total assets denotes the capital assets ratio (KA). Total operating cost divided by total income is a proxy for efficiency (CI), while the ratio of non-performing loans to total loans is used as a proxy for credit risk (NPL). MS denotes market share defined as the share of bank i 's assets as a percentage of the total assets of all banks within a specified state. Bank size, as measured by banks' total assets is also included in the vector, as well as bank growth, defined as the change in bank size, or change in total assets of a bank.

Bank size can have either a positive or negative effect on profit. For instance a large bank may have reached its current size as a result of superior performance, in which case one would expect a positive relationship between size and profit. On the other hand, large banks may in fact be operating inefficiently, in which case there may exist a negative relationship between size and profit. Furthermore, small banks typically extend credit to more risky customers, thus charging a higher risk premium, reflected by a higher interest rate margin, which in turn feeds through to higher revenues and profits. In contrast, Martinez-Peria and Mody (2004), argue that banks with larger market shares can charge higher rates on loans, therefore boosting revenues

and profitability. Other studies, for instance Yurtoglu (2004) and Gschwandtner (2005), find no significant correlation between firm size and profit.

The change in bank size, i.e. the change in the total assets of each bank, is also included in the regression as a proxy for bank growth (following Short (1979) and Bourke (1989) among others). Typically the relationship between bank growth and profitability is expected to be positive. Yurtoglu (2004) reports a positive correlation between firm growth and long run profit persistence, significant only at the 10% level.

As a result of both deregulation and technological innovation, for instance the passage of the 1999 Gramm-Leach-Bliley Act in the US, banks have been able to diversify into areas including insurance underwriting, investment banking and asset management. Thus, non-interest income has increasingly accounted for a larger proportion of banks income (Stiroh, 2004b). Including the DIV covariate in the profit equation enables analysis of the relationship between diversification and profitability. Numerous authors have examined the relationship between diversification and financial performance including DeYoung and Rice, 2004; Stiroh and Rumble, 2006; Carbo-Valverde and Fernandez, 2007; Laeven and Levine, 2007; Mercieca et al., 2007; Lepetit et al., 2008. The consensus from the literature suggests that there appears to be no definitive correlation between diversification and bank profitability.

LA is included in the profits equation to enable us to examine the ability of banks to respond to unexpected (exogenous) shocks. A bank that is less liquid (i.e. one with a relatively high loans-to-assets ratio) is less likely to be able to meet liquidity needs that arise as a result of unexpected shocks as a high proportion of its assets are tied-up in other investments. Berger et al (2005) argue that the size of banks, their ownership structure and the extent to which they are focused on retail banking activities,

are all factors that influence the extent to which banks create liquidity. Berger and Bouwman (2009) also report that there exists a significant positive relationship between the extent of bank liquidity and bank value. As a result, one would expect a positive relationship between LA and profitability.

Various authors have examined the significance of LA ratios when used as a proxy for lending specialisation. Freixas (2005) provides evidence which suggests that a high LA ratio may provide informational advantages which potentially lower intermediation costs and improve profitability. Degryse and Ongena (2007) examine the influence of switching costs (including search costs and informational costs) on the development of relationship banking as opposed to transaction banking, given that these costs represent a major source of rents for banks.

Banks that adopt an over-cautious approach when analysing investment opportunities, are more likely to overlook such opportunities, thus may forego potential returns. Such banks may exhibit an excessively high capital-assets ratio (KA). Banks with low capital-assets ratios may endure high costs of insurance against bankruptcy. Thus, Berger (1995b) suggests there exists a positive relationship between the capital-assets ratio and bank performance. An alternative, namely signalling, hypothesis argues that managers have access to privy information regarding the future performance of an institution as well as a stake in the bank (shares). Therefore, as Hughes and Mester (1998) argue, it may be less costly for managers of low risk banks to signal quality by maintaining a high capital-assets ratio than managers of high risk institutions. Overall, there is no clear relationship between KA and profitability.

The cost-income ratio (CI) is included in the regression as a proxy for bank efficiency. Efficient banks are more likely to be more profitable than inefficient banks.

That is, banks that are run efficiently are more likely to have more profitable assets and lower cost liabilities. However, if efficiently run banks pass their lower costs onto consumers in the form of lower loan rates and/ or higher deposit rates, the profitability of such banks will be reduced. Berger (1995a) and Goddard et al (2001) find that more efficient banks earn higher profits when analysing data for the US and Europe. This evidence suggests that more efficient banks earn higher profits as a result of superior management and technology, irrespective of the size of the bank.

The ratio of non-performing loans to total loans is included in the regression in order to capture the effects of credit risk on bank profitability. Numerous authors, including Salas and Saurina (2002), Berger and Udell (2004) and Ruckes (2004) argue that periods of increased lending may result in an increase in the number of non-performing loans. This may be due to the relaxation of stringent lending standards by bank managers in response to competitive pressures that arise as a result of short-term profit targets set by bank owners. Rajan (1994) argues that banks that focus on short run competition may relax credit standards in order to enhance asset growth and profitability. Guttentag and Herring (1984) and Herring (1999) discuss the occurrence of disaster myopia in the context of the ratio of NPL to TL. Disaster myopia refers to a situation whereby banks fail to correctly appraise the effect of a major shock on their loan books. Myopia may be exasperated by the actions of overconfident bank managers whereby they may engage in excessive lending in order to fund investments, thus potentially leading to an increase in non-performing loans in the future. Typically, one would expect the relationship between non-performing loans and profitability to be negative.

Previous studies have typically uncovered a positive and highly significant relationship between market share and profitability. For example, Berger (1995a) argues that only firms with large market shares, and well differentiated products, are able to extend their market power when setting the price of these products. As such, these firms are able to earn above normal profits. Other examples include Shepherd (1972), Mullin et al (1995) and Marion et al (1979). In order to control for the effect of market share on bank profitability, MS (defined as the share of bank i 's assets as a percentage of the total assets of all banks within a specified market), is included in Equation (1). However, market share is often employed as a proxy for diversification. In this circumstance, most studies find that there exists a negative correlation between profitability and diversification (e.g. Ravenscraft (1983), and Lang and Stulz (1994)).

Industry and Macroeconomic Regressors

M_t represents a vector of industry and economic-specific regressors comprising the Herfindahl-Hirschman index (HHI), calculated as the sum of the squares of each individual bank's market share and used as a measure of industry concentration, as well as GDP which refers to growth in national gross domestic product.

The HHI variable, Herfindahl-Hirschman Index, is a measure of industry concentration. The HHI is calculated as follows, $HHI = \sum_{i=1}^N s_i^2$, where s_i , in this circumstance, is market share of bank i , and N is the total number of banks in the industry. The assumptions underlying much of the earliest research into market or industry concentration are based on the SCP paradigm which stipulates a strong causal link between market concentration and the performance of firms within the defined market. Incumbents in highly concentrated industries may be able to prevent entry to

the market by new firms, and as a result may enjoy a higher degree of profit persistence. Numerous authors have reported a positive relationship between concentration and various measures of profitability (e.g. Yurtoglu (2004) and Kambhampati (1995)). While the traditional SCP approach argues that banks in more concentrated markets set lower deposit rates and higher loan and fee rates, it should also be noted that banks in such markets may conversely choose to set prices at lower rates in order to prevent entry by new banks. A number of authors have argued that the relationship between concentration and profitability is rather mixed and inconclusive (Gilbert (1984), Scherer and Ross (1990), Berger (1995b), Berger et al. (2004)). For instance, the relationship may be positive if firms in the industry maintain high prices in order to increase profits. Alternatively, there may be a negative relationship if these firms maintain low prices in order to deter entry into the industry. The authors also argue that if these two effects cancel each other out, the relationship between concentration and profitability may not significantly differ from zero. In contrast to the SCP approach, numerous authors have argued that market concentration may be the result of more efficient banks 'endogenously' gaining larger market shares. Ravenscraft (1983) and Odagiri (1992) have both argued that industry concentration had a negative effect on profitability when including market share as an explanatory variable in the model. Mueller (1986, 1990) also uncovers a negative relationship between concentration and profitability when analysing US data. He argues that as concentration increases so too does non-price competition, while profits on the other hand decline.

GDP is included in the regression in order to control for fluctuations in output or macroeconomic conditions. It is expected that profits would follow the economic cycle. That is, during periods of economic expansion this would lead to increased bank profits.

For example, there would be greater demand for loans from businesses and individuals, and greater demand for consulting services. Equally, during an economic downturn banks would have less profit opportunities. For example, there would be an increase in bad loans and a reduction in the demand for fee-based services. Thus we would expect the coefficient on GDP growth to be positive.

The model specification in equation (1) is subject to two possible, related, drawbacks. In particular there is the potential for an endogenous variable contained in the vector X_{it} or M_{it} to appear on the right-hand side of the equation. Such regressors could be correlated with the error term and lead to biased and inefficient estimation. A second problem will arise through correlation between the lagged dependent variable and the fixed effects. In particular, where the fixed effect is believed to condition the left-hand side variable, then, as a constant, it will also be correlated with the lagged dependent variable on the right-hand side. To circumvent these problems and to act as a robustness check on the fixed effects model considered above, we also estimate the GMM approach considered by Arellano and Bond (1991) and first proposed by Holtz-Eakin, Newey and Rosen (1988). The GMM approach of Arellano and Bond, often referred to as the difference-GMM approach transforms the model in equation (1) into the following and effectively treats the model as a system of equations, one for each time period:

$$\Delta\pi_{it} = D_t + \lambda_i\Delta\pi_{i,t-1} + \lambda_i\Delta\pi_{i,t-1}D_t + \beta_1\Delta X_{it} + \beta_2\Delta M_t + \Delta u_{it} \quad i = 1 \dots N; t = 1 \dots T \quad (4.2)$$

By transforming the regressors through first-differencing, the bank specific fixed effects are removed. The method of Arellano and Bond uses lagged levels of the variables to instrument for the difference in equation (2). However, lagged levels may be poor

instruments for first differences, especially where there may be a large autoregressive parameter.

To counter this problem, Arellano and Bover (1995) described how, if the original equations in levels were added to the system, additional moment conditions could be brought to bear to increase efficiency. In these equations, both predetermined and endogenous variables in levels are instrumented with suitable lags of their own first differences. Blundell and Bond (1998) articulated the necessary assumptions for this augmented estimator more precisely, in particular that first differences of instrument variables are uncorrelated with the fixed effects. Where the original estimator is referred to as difference-GMM, this augmented estimator is referred to as system-GMM, as there are two equations one for levels and one for differences.

Finally, as GMM estimators, the Arellano-Bond estimators have one- and two-step variants for the GMM weights. Asymptotically, the two-step estimator is more efficient, although in finite samples the standard errors can be downward biased. Nonetheless, a finite-sample correction to the two-step covariance matrix has been derived by Windmeijer (2000). This improves the efficiency of the two-step method, especially for system GMM.

4.4. Data and Results.

4.4.1 Profits Data and Summary Statistics.

The initial dataset was constructed by collecting data for all US banks over the period 1976 to 2009 from the Report of Condition and Income, referred to as the Call Reports. This data is used in presenting summary statistics, although the estimations take place over the period 1984 to 2009, due to data availability for some variables. Every

National Bank, State Member Bank and insured Non-member Bank is required by the Federal Financial Institutions Examinations Council (FFIEC) to file a Call Report on the last day of each calendar quarter (i.e. the report date). The FDIC is responsible for overseeing insured financial institution adherence to FFIEC reporting requirements (which depend upon the size of the bank and whether it has any foreign offices), including the observance of all bank regulatory agency rules and regulations, accounting principles and pronouncements adopted by the Financial Accounting Standards Board (FASB) and all other matters relating to a Call Report submission. The Call Report collects basic financial data of commercial banks in the form of a balance sheet, an income statement and supporting schedules. The Report of Condition schedules provide details on assets, liabilities and capital accounts. The Report of Income schedules provide details on income and expenses. As can be seen from the data, the total number of US banks has significantly declined throughout the sample period, from 15264 banks in 1976 to 7572 banks in 2009. Following Berger et al. (2000), banks with total assets of less than \$100 000 are excluded from the sample. The banks are omitted as they tend to be short-lived and exhibit very different business behaviour relative to other banks (DeYoung, 2003). Furthermore, in order to minimise the potential impact of outliers, we also exclude banks with equity less than 1% of their total assets.

Table 4.1 presents the summary statistics for bank profits, measured by return on assets (ROA) and return on equity (ROE), by year over the period 1976 to 2009. These include mean and median to capture measures of central tendency and the standard deviation to measure dispersion. Examining each statistic in turn, taking first the mean values, from 1976 the ROA has increased gradually from 0.008 to 0.011 in 1980. From that period the ROA declines year on year until it reaches a trough of 0.004 in 1986,

whereupon it increases again to reach 0.011 in 1993. From 1993 until 2006 the ROA remains approximately constant, fluctuating only between 0.010 and 0.011. The only exception to this occurs in 2001 where ROA is 0.009, this being a recession year. The ROA declines from 2007 to 2009. This is associated with the liquidity crisis that began in the summer of 2007. With regard to the median, this series largely follows the same trends as the mean values. More specifically we can see it rising over the period 1976 to 1980, declining steadily between 1981 and 1986. From this period until the early 1990s it increases. From approximately 1992 it fluctuates between 0.010 and 0.011. Finally, the median declines in 2007 and 2008, reaching its lowest value of 0.002 in 2009. This is again associated with the liquidity crisis.

With regard to the measure of dispersion, there appears to be no obvious pattern in the data over time. For example, taking the standard deviation for the first four years it is approximately 0.07, then it increases in the 1980s from 0.01 up to a high of 0.05 in 1989, although this increase is not monotonic. During the 1990s the standard deviation is less variable, ranging between 0.02 and 0.03, but becomes more variable in the 2000s, ranging from 0.02 to 0.07.

Table 4.1. Summary Statistics for Profit Measure						
	Return on Assets (ROA)			Return on Equity (ROE)		
Year	Mean	Median	Std Dev	Mean	Median	Std Dev
1976	0.0084	0.0092	0.0078	0.1036	0.1190	0.1147
1977	0.0086	0.0092	0.0069	0.1084	0.1202	0.0918
1978	0.0093	0.0098	0.0068	0.1158	0.1256	0.0879
1979	0.0106	0.0109	0.0071	0.1266	0.1354	0.0898
1980	0.0107	0.0111	0.0078	0.1243	0.1333	0.0999
1981	0.0104	0.0107	0.0088	0.1152	0.1280	0.1229
1982	0.0090	0.0103	0.0140	0.0964	0.1235	0.2051
1983	0.0079	0.0096	0.0120	0.0820	0.1178	0.2366
1984	0.0065	0.0091	0.0136	0.0626	0.1105	0.2755
1985	0.0056	0.0090	0.0166	0.0439	0.1092	0.3695
1986	0.0044	0.0080	0.0179	0.0140	0.0973	0.4331
1987	0.0052	0.0082	0.0304	0.0219	0.0953	0.3764
1988	0.0064	0.0088	0.0144	0.0487	0.1017	0.3338
1989	0.0076	0.0092	0.0462	0.0667	0.1055	0.3598
1990	0.0064	0.0086	0.0488	0.0493	0.0991	0.3303
1991	0.0071	0.0089	0.0157	0.0653	0.1016	0.2343
1992	0.0095	0.0107	0.0322	0.1013	0.1194	0.1975
1993	0.0111	0.0114	0.0172	0.1131	0.1222	0.1469
1994	0.0109	0.0109	0.0157	0.1098	0.1176	0.2360
1995	0.0114	0.0110	0.0394	0.1113	0.1132	0.1359
1996	0.0110	0.0112	0.0179	0.1105	0.1146	0.0905
1997	0.0115	0.0113	0.0326	0.1116	0.1130	0.1697
1998	0.0108	0.0106	0.0314	0.1050	0.1079	0.1514
1999	0.0105	0.0104	0.0329	0.1079	0.1085	0.1541
2000	0.0108	0.0103	0.0727	0.1019	0.1037	0.1888
2001	0.0095	0.0096	0.0420	0.0902	0.0963	0.1419
2002	0.0104	0.0103	0.0328	0.0992	0.1015	0.1091
2003	0.0108	0.0101	0.0543	0.0994	0.0988	0.1317
2004	0.0103	0.0101	0.0239	0.0999	0.0992	0.0984
2005	0.0105	0.0103	0.0273	0.1038	0.1019	0.0975
2006	0.0100	0.0100	0.0407	0.0980	0.0970	0.1085
2007	0.0097	0.0091	0.0509	0.0813	0.0850	0.1525
2008	0.0062	0.0066	0.2948	0.0544	0.0389	0.5158
2009	0.0040	0.0031	2.0377	0.0236	0.0218	3.1725
Notes: Entries are for the mean, median and standard deviation for US commercial bank profits as measured by ROA (return on assets) and ROE (return on equity) over the period 1976 to 2009.						

There is an abnormally large standard deviation in 2008 of 0.29. In 2009 the standard deviation is 11.89. Again, these abnormal observations are the result of the financial crisis.

The statistics for the ROE are broadly consistent with those reported for the ROA. Of note, for example, we see the same general pattern in mean and median profit, with ROE increasing from the start of the sample until around 1980, decreasing between 1980 and 1986 before increasing again to 1993, where the value largely plateaus. Finally, ROE decreases in the liquidity crisis years of 2007, 2008 and 2009. Elsewhere, the standard deviation fluctuates without any obvious pattern, but is generally higher in the mid-to-late 1980s and lower in the 2000s, excepting for the crisis years. For interest Table 4.2 reports the same summary statistics for the exogenous variables.

To illustrate some of the more pertinent points above, Figure 4.1 graphs the mean and median ROA and the number of banks over the sample period. To reiterate we can see in the graph of mean ROA a gentle increase in average bank profit until 1980, followed by a decrease until 1986. Subsequently, average bank profit increases until the early 1990s and then plateaus, with a fall in ROA at the end of the sample associated with the liquidity crisis. For comparison, the median value is more stable throughout the entire sample period but exhibits the same fall at the end of the sample period.

Figure 4.1 also shows the number of banks over time. Here we can see that the number of banks remains approximately constant between 1976 and 1986, with more than 14000 banks. From 1987 the number of observations declines monotonically until 2008, during which there is an increase in the exit rate of banks as a result of the

liquidity crisis. In 2009 the number of banks increases again, but does not reach pre-crisis levels.

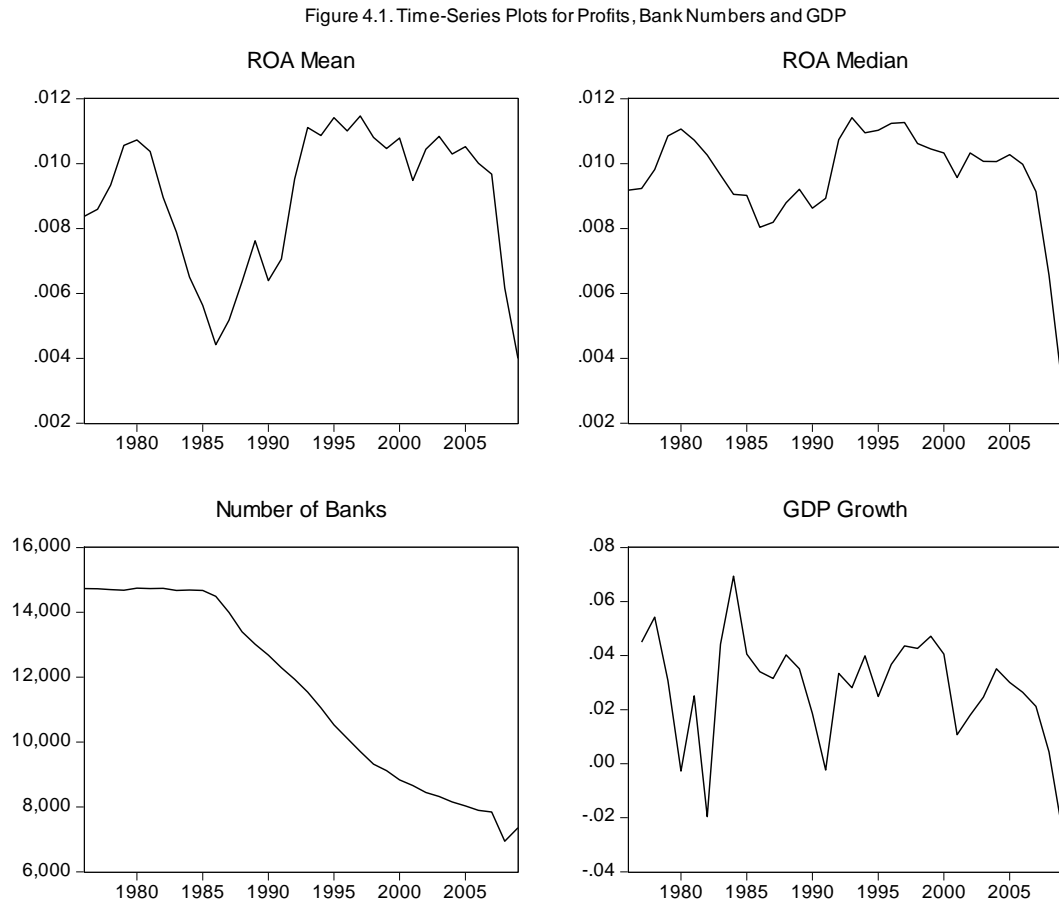


Figure Note: Left Hand Scale presents the series values; Bottom Scale represents time period

Also presented in Figure 4.1 is the annual change in GDP. This is to examine the nature of any relationship between average bank profit and the change in GDP. More specifically, are the dynamics of bank profit pro-cyclical, acyclical or counter-cyclical. Evident from

Table 4.2. Exogenous Variables Summary Statistics								
	Bank Size	Bank Growth	KA	NPL	LA	DIV	CI	GDP Growth
Mean	10.9543	0.0926	0.2033	0.0363	0.5554	0.2582	0.4347	0.0281
Med.	10.8043	0.0703	0.0855	0.0015	0.5696	0.0769	0.3731	0.0315
Std. Dev.	1.4810	0.2956	13.8648	10.3067	0.1677	19.3562	1.5732	0.0196
Skew.	0.8023	-0.7072	249.9591	521.4291	-0.542	202.2328	257.6687	-0.859
Kurt.	5.3888	199.7575	76253.89	276790.9	3.7942	46711.05	94324.58	3.8941
Notes: Variable definition: Bank size is measured by (log) total assets; bank growth is the change in bank size (first difference of log); KA is equity to assets and denotes the capital assets ratio; NPL is non-performing loans to total loans and is a proxy for credit risk; LA is loans to assets and is a proxy for liquidity; DIV is non-interest income to total income and is a proxy for diversification; CI is non-interest expenditure to total income and is a proxy for efficiency; GDP growth is the rate of change in GDP and measures overall economic performance. Med. is the median value, Std. Dev. is the standard deviation, Skew. is skewness and Kurt. is the kurtosis value.								

Figure 4.1 is that there has been a change in the nature of the relationship. From the start of the sample period until the early 1990s the relationship was counter-cyclical, that is as GDP rises mean bank profits fall and vice-versa. In the second half of the dataset the relationship appears to be pro-cyclical, with GDP and average bank profits rising and falling together. In addition, there appears to be a lead/lag relationship between the two variables. In particular, in the first half of the sample the turning points in GDP appear to occur one or two periods before the turning points in average bank profits. In the second half of the sample the relationship appears to be more contemporaneous.

Figure 4.2 shows a graph of HHI plots for all banks in the dataset. Given that the measure is computed for all banks (over 20,000) and for all states (each of which has their own legislative framework and competitive environment) the precise estimate should not be interpreted in the usual way. Thus, the graph is for illustrative purposes only; however, it does demonstrate the general pattern that this concentration measure has taken over the sample period. In particular, from 1979 (which observed a small rise

Figure 4.2. National HHI Measure Over Time

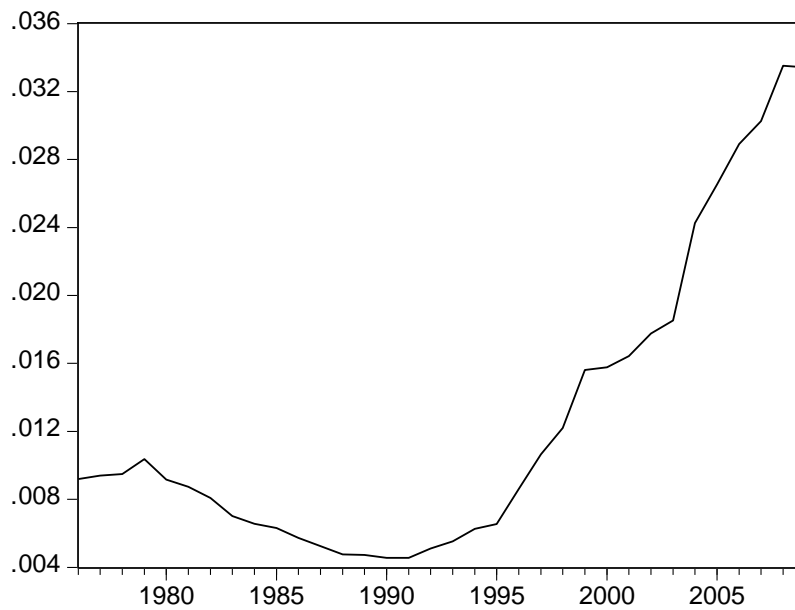


Figure Note: Left Hand Scale presents the series values; Bottom Scale represents time period

in the HHI value), concentration has been falling; however, the early 1990s and, notably, from 1995, the HHI value has increased quite dramatically. While this rise in value slowed during the late 1990s and early 2000s, large increases are again noticeable from 2003 onwards. The plateauing at the end of the sample is likely related to the crisis and could not be assumed to continue. See Chapter 2, Sections 2.5 and 2.6, for background discussion.

4.4.2. Empirical Results.

Table 4.3 presents the empirical results for US bank profits based on equation (4.1). We consider five different specifications of the basic model. The first includes the key determining variables as outlined in Section 3, while model specifications 2-4 extend

that model by including the dummy variable are outlined above. In particular, model two includes a dummy for the 1999 Gramm-Leach-Bliley Act (also known as the Financial Modernization Act) which repealed part of the Glass-Steagall Act of 1933. As such commercial banks, investment banks, securities firms and insurance companies were no longer prohibited from consolidating. Model three includes a dummy for the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act which repealed the interstate restrictions of the Bank Holding Company Act (1956). The 1994 Act therefore permitted interstate mergers between banks, subject to a number of criteria. Model four includes a dummy for the 2007-2009 financial crisis, triggered by a liquidity shortfall in the US banking system. Finally, model five uses model four but estimated using a System Generalised Method of Moments (GMM) estimator.

Prior to considering the estimation results, we can see from the specification tests at the bottom of the table that for Models 1 to 4 there is weak evidence of residual autocorrelation and some evidence of heteroscedasticity (Breusch-Pagan test). This supports the use of robust *t*-statistics. The Hausman test supports the use of fixed effects, while the R-squared values are relatively low at 6%. For Model 5, the GMM estimation, both the autocorrelation test and the J-statistics for the validity of the instruments do not support the model. Turning to the coefficient values, the results for Model 1 are presented in the first column of Table 4.3. This model presents the results of estimating equation (4.1) over the full sample of data. The key parameter in this model, for our purposes, is the first-order autocorrelation coefficient. This parameter measures the degree of persistence in bank profits and while it is statistically significant, it has a low value, of 0.094. This suggests that bank profits exhibit very little persistence and implies that over the full sample the banking system appears competitive and thus

effective in eroding abnormal profits back to their mean values. To present the same information in a more meaningful way we can convert the autoregressive parameter into a half-life, which measures the time (in years) that it takes for half of a shock to bank profits to dissipate. The half-life is calculated as $\log(0.5)/\log(\lambda)$, where λ is the autoregressive parameter. The calculated value is 0.29 and suggests that half of a shock disappears within under a third of a year. Of the remaining variables four are statistically significant and negative (size, growth, loans to assets and non-interest expenditure to total income), while one is statistically significant and positive (the HHI). The negative coefficient on the bank size variable could suggest that as banks become larger so markets become more contestable, putting pressure on profits. Indeed, some evidence exists to suggest that while banks become more efficient with size, they also sacrifice profit (e.g., Claessens and Laeven, 2004).

Table 4.3. Empirical Results – ROA					
Coefficients	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	0.017** (2.94)	0.021** (3.10)	0.020** (2.70)	0.020** (2.72)	-
ROA(-1)	0.094** (5.48)	0.073** (3.99)	0.093** (4.20)	0.093** (4.19)	0.086** (16.25)
ROA(-1) *D1999	-	0.168** (3.56) [0.241]	0.206** (3.91) [0.238]	0.260** (4.56) [0.293]	0.201** (9.11) [0.215]
ROA(-1) *D1994	-	-	-0.061 (-1.63) [0.032]	-0.060 (-1.61) [0.033]	-0.072** (-12.85) [0.014]
ROA(-1) *2007	-	-	-	-0.224** (-2.48) [0.069]	-0.141** (-9.28) [0.074]
Bank Size	-0.001* (-2.19)	-0.002** (-2.45)	-0.001* (-2.14)	-0.001* (-2.17)	-0.005** (-2.49)
Bank Growth	-0.011** (-8.83)	-0.010** (-8.52)	-0.011** (-8.54)	-0.010** (-8.30)	-0.011** (-4.18)
KA	-3.60e-06 (-0.10)	-2.66e-06 (-0.08)	-2.62e-06 (-0.07)	-2.86e-06 (-0.08)	-0.0001 (-0.92)
NPL	-1.83e-06 (-0.06)	-3.10e-06 (-0.10)	-3.09e-06 (-0.10)	-3.40e-06 (-0.11)	-0.001** (-4.52)
LA	-0.006* (-2.18)	-0.007* (-2.31)	-0.006* (-2.24)	-0.006* (-2.22)	-0.056** (-5.56)
DIV	-1.75e-05 (-0.09)	-1.96e-05 (-0.11)	-1.90e-05 (-0.10)	-1.89e-05 (-0.10)	0.025* (2.13)
CI	-0.006** (-7.11)	-0.006** (-7.00)	-0.006** (-6.96)	-0.006** (-6.90)	-0.058** (-25.80)
GDP Growth	0.012 (0.66)	0.014 (0.77)	0.015 (0.82)	0.013 (0.71)	-0.0003 (-0.08)
HHI	0.028** (6.63)	0.027** (6.33)	0.028** (6.29)	0.028** (6.26)	0.051** (6.40)
Market Share	0.006 (0.26)	0.007 (0.30)	0.006 (0.28)	0.006 (0.27)	-0.218** (-2.89)
Dummy 1999	-	0.001 (0.67)	0.001 (0.78)	0.001 (0.88)	0.001** (2.56)
Dummy 1994	-	-	-0.0002 (-0.31)	-0.0002 (-0.30)	0.002* (2.27)
Dummy 2007	-	-	-	-0.001 (-0.44)	-0.0001 (-0.39)
R-sq	0.06	0.06	0.06	0.06	0.05
Q1 / AR(2)	0.07	0.09	0.05	0.05	0.04
Heter / J	0.04	0.04	0.06	0.08	0.04
Hausman	0.00	0.00	0.00	0.00	-

Notes: The dependent variable is the de-meaned return on assets (ROA). Entries for Models 1 to 4 are coefficient values for equation specification (4.1), where each model differs by the inclusion of an extra dummy variable (D or Dummy) that takes the value zero before the noted date and one afterwards, where the dummy for 2007 represents the

financial crisis. Model 5 is given by equation specification (4.2) and is the GMM estimation; see discussion and related text (pages 125 and 133). For variable definitions see Table 4.2. Numbers in parentheses are *t*-values robust to autocorrelation and heteroscedasticity. Numbers in brackets are the sum of the coefficients where dummy variables are used. R-sq is the R-squared value of the model, Q1 (AR(2)) is a test of first-order serial correlation (second order for the GMM model). Heter is a test for heteroscedasticity, while J is the Hansen J test for the validity of the instruments in GMM estimation. Hausman is the test for random effects over fixed effects. For these latter three tests entries are *p*-values. * (**) indicate 5% (1%) statistical significance.

This result differs from that of Yurtoglu (2004) and Gschwandtner (2005), for the manufacturing sectors, who did not find any significant correlation between firm size and profit persistence. Likewise the negative coefficient on bank growth differs from Yurtoglu (2004) who reported a positive effect, again for manufacturing firms. However, a negative effect could arise from costs associated with growth. That is, profits decline in correspondence with bank growth, as banks reinvest previously accrued profit in order to fund growth. The negative coefficient on the loans to assets variables supports the view that banks with larger loans to assets ratio are more susceptible to adverse shocks. That is, banks with higher loan to assets ratios are relatively more illiquid. The negative coefficient on non-interest expenditure to total income suggests that a bank with a higher cost to income ratio is relatively less efficient and thus has a poorer profit performance. Finally, the positive and significant coefficient on the HHI supports the view that the more concentrated an industry the higher profits will be, in line with the SCP hypothesis.

The results from estimating Model 2 are presented in the second column of results in Table 4.3. Model 2 differs from Model 1 only by including a dummy variable for the legislative change in 1999 whereby banks were allowed to merge with other non-bank organisation, thus allowing banks to provide services that were not traditionally associated with banking (insurance underwriting for instance). The dummy is included

by itself but, of more interest to this study, is also included as an interaction term with the AR(1) coefficient. To interpret these coefficients, the AR(1) parameter now refers to the strength of autocorrelation (profits persistence) in the period up to 1999, while the sum of the AR(1) parameter and the AR(1) multiplied by the dummy equate to the persistence of profits after 1999 and is given by the number in brackets. Here we can see, in comparison to Model 1 that represents the full sample, there is a slight decline in profits persistence in the period prior to 1999. However, following 1999 and the repeal of the Glass-Steagall Act, profits persistence increases. This would be consistent with the view that the repeal of the Act allowed banks to diversify into other areas of activity and increase potential profit streams.⁸

The results from estimating Model 3 are presented in the third column of results in Table 4.3. Model 3 differs from the previous model via the inclusion of a dummy variable for the legislative change in 1994 which permitted interstate mergers between banks (Riegle-Neal Interstate Banking and Branching Efficiency Act). Again, the dummy is included by itself but is of more interest to this study when included as an interaction term with the AR(1) coefficient. In this model, the AR(1) parameter refers to the strength of autocorrelation (profits persistence) in the period up to 1994. The sum of the AR(1) parameter and the AR(1) parameter multiplied by the 1994 dummy equate to the persistence of profits in the period post 1994 to 1999. The sum of the AR(1) parameter, the AR(1) parameter multiplied by the 1994 dummy and the AR(1) parameter multiplied by the 1999 dummy equate to the profit persistence in the period post-1999, again these are represented by the numbers in brackets. In this instance we can see that profits persistence pre-1994 is almost identical to the profits persistence for

⁸ Although the diversification variable is not significant in the regression, it is felt that diversification may impact on persistence rather than profit in this analysis.

the full sample (shown in Model 1). Profits persistence then dramatically declines following the passage of the 1994 Act, suggesting that removing interstate banking restrictions increased competition. Following the 1999 repeal of the Glass-Steagall Act, profits persistence increased to the same level as found in Model 2. Again, this would be consistent with the notion that the Gramm-Leach-Bliley Act increased potential profit streams as banks were permitted to diversify into areas of activity beyond traditional banking.

The results from estimating Model 4 are presented in the fourth column of results in Table 4.3. Model 4 differs from, and extends, the previous models through the inclusion of a dummy variable for the financial crisis (credit crunch) that began in 2007. As in the previous models, the dummy is included both by itself and as an interaction term with the AR(1) coefficient, given in square brackets. Again, profits persistence in the period up to 1994 is given by the AR(1) parameter. The sum of the AR(1) parameter and the AR(1) parameter multiplied by the 1994 dummy equate to the persistence of profits in the period post 1994 to 1999. The sum of the AR(1) parameter, the AR(1) parameter multiplied by the 1994 dummy and the AR(1) parameter multiplied by the 1999 dummy equate to the persistence of profits in the period post 1999 to 2007. Finally, the sum of the AR(1) parameter, the AR(1) parameter multiplied by the 1994 dummy, the AR(1) parameter multiplied by the 1999 dummy and the AR(1) parameter multiplied by the CC dummy equate to the persistence of profits in the period post 2007. The results for this model follow the same pattern found in Model 3 as profits persistence pre-1994 is similar to that found in the full sample, followed by a relatively large decrease for the period post-1994 to 1999. Again following the pattern found in Model 3, the profits persistence then experiences a dramatic increase over the

period 1999 to 2007 as discussed above. Furthermore, in this instance we can see that profits persistence in the period post-2007 then experiences a dramatic fall. This coincides with the financial crisis which began in 2007, and was caused as a result of a liquidity shortfall in the US banking system, triggered by a collapse in the housing market. This collapse subsequently resulted in a dramatic decline in the value of securities tied in to real estate pricing, affecting the level and volatility of banks and other financial institutions around the world (Bech and Rice, 2009; Lee and Rose, 2010; De Haan and Poghosyan, 2012).

Model 5 presents the results of estimating the Arellano and Bover system GMM. As noted above the inclusion of this approach is motivated by the possibility of bias induced in the fixed-effects estimator through possible correlation between the lagged dependent variable and the fixed effects. Flannery and Hankins (2013) undertake a large scale Monte Carlo exercise to examine the effect of bias within the dynamic panel model and the effectiveness of alternative proposed solutions. For the purposes of the study here, Flannery and Hankins find that the fixed effects approach is reasonable (biased is minimised) in estimating exogenous variables, while the effect of bias on the lagged dependent variable is lessened, when the time series element of the panel is greater than twelve years, when there is more than one exogeneous variable, when the degree of autocorrelation is low and when the panel is unbalanced with missing observations, all conditions present here. Nonetheless, we proceed with the GMM estimation as the bias can still be present in the fixed effects model.

The results from estimating Model 5 are presented in the fifth column of results in Table 4.3. As noted above there are several approaches that can be taken in estimation. The results presented in this table are based on the Arellano and Bover

system GMM method. Experimentation with the Arellano and Bond (1991) difference-GMM approach produced qualitatively similar results. As in the previous models the dummy is included both by itself and as an interaction term with the AR(1) coefficient. The time periods and corresponding calculations of the persistence of profits are the same as those found in Model 4 and therefore will not be repeated here. The results for this model follow the same pattern demonstrated by Model 4. Profits persistence pre-1994 is of a similar level (although slightly lower) to that found in the previous models (notably for Models 1, 3 and 4, of further interest Flannery and Hankins demonstrate that any bias in the fixed effects model would be to underestimate the coefficient on the lagged dependent variable). Again, there is a decline in profits persistence for the period post-1994 to 1999. This is then followed by an increase in profits persistence for the period post-1999 to 2007. The decline in profits persistence in the period post-2007 is also observed in this model. The rationale for the changes in profits persistence over the time period discussed remains the same as discussed in the models above. Of further interest, the parameter values reported for Model 5 are broadly similar to those reported for Model 4. This suggests that any bias in the fixed effects model is moderated as suggested by Flannery and Hankins given the dimensions of the panel and the strength of autocorrelation.

Table 4.4 reports the results of estimating the same five models are reported in Table 4.3 but using ROE as the measure of profit. As with the results for ROA, the specification tests indicate that the fixed effect panel models pass the residual tests but have a low R-squared. Again the GMM model does not pass the specification tests. The coefficient results in Table 4.4 are broadly consistent with those reported in Table 4.4, of particular note, is that persistence is generally quite low. This is in contrast to the

results reported by Goddard et al. (2011) for the US, although more similar to Tregenna (2009). Persistence falls after the introduction of the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act, increases after the 1999 Gramm-Leach-Bliley Act and falls again during the liquidity crisis period. Thus, the pattern of results is replicated across both measures of profits. With respect to any differences, although they are small, the degree of persistence is marginally higher with the ROE, while the impact of the 1999 Act appears smaller (except for Model 4). Finally, the results from the GMM approach do differ slightly from the fixed effects model, notably, the AR(1) parameter is higher. This suggests that any bias in the fixed effects approach may be more prevalent when using the ROE measure. This could be related to the ROE results exhibiting a slightly higher degree of autocorrelation.

Overall, in considering the range of results presented here, we can suggest three key findings. First, and perhaps at the most basic level, the general level of persistence in profit for US commercial banks is relatively low, and typically more so than that reported for manufacturing firms. This suggests that over the sample period considered the US bank market can be characterised as competitive, albeit not perfectly. Second, that the impact of regulation designed to enhance competition does affect the degree of persistence and, hence, competition. In the sample considered here, we observe that the Interstate Banking Act of 1994 lead to a reduction in the degree of profit persistence, perhaps indicating an increase in competition by allowing cross-state activity. In contrast, profit persistence increased following the 1999 Gramm-Leach-Bliley Act. While taken at face value this may suggest a lower degree of competition. However, it is also possible that this may not be the case, but rather, as the Act allowed banks to generate income from alternative sources, persistence may have increased due to banks

diversifying their activities. Finally, therefore, the results support the view that profit persistence can vary over time in contrast to the usual assumption that it remains constant. The results also suggest, in reference to the results for the 1999 Act dummy, that whether changes in persistence imply changes in competition needs to be scrutinised and not taken at face value.

4.5. Summary and Conclusion.

This purpose of this chapter is to examine the influence of regulatory changes on the persistence of profits for US commercial banks during the period 1976 to 2009. More specifically, the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act (which permitted interstate mergers between banks, subject to a number of criteria) and the 1999 Gramm-Leach-Bliley Act (which allowed the consolidation of commercial banks, investment banks, securities firms and insurance companies). In addition, the impact of the recent financial crisis is also examined.

Table 4.4. Empirical Results – ROE					
Coefficients	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	-0.010 (-0.30)	0.088** (2.37)	0.074 (1.80)	0.092* (2.22)	-
ROE(-1)	0.131** (15.75)	0.126** (14.47)	0.134** (14.35)	0.135** (14.40)	0.219 (23.25)
ROE(-1) *D1999	-	0.046 (1.82) [0.172]	0.097** (2.95) [0.169]	0.221** (5.55) [0.298]	0.050 (2.03) [0.089]
ROE(-1) *D1994	-	-	-0.062** (-2.42) [0.072]	-0.058* (-2.28) [0.077]	-0.180 (-11.34) [0.039]
ROE(-1) *2007	-	-	-	-0.251** (-5.60) [0.047]	-0.193 (-4.76) [-0.104]
Bank Size	0.005 (1.60)	-0.004 (-1.11)	-0.003 (-0.70)	-0.004 (-1.12)	0.026 (4.13)
Bank Growth	0.015* (2.16)	0.018** (2.73)	0.018** (2.61)	0.021** (3.02)	0.068 (9.26)
KA	4.58E-07 (0.002)	2.42E-06 (0.01)	3.47E-06 (0.02)	-6.86E-06 (-0.04)	0.002 (0.54)
NPL	-2.32E-05 (-0.14)	-2.47E-05 (-0.15)	-2.49E-05 (-0.15)	-2.50E-05 (-0.15)	-0.005 (-0.97)
LA	-0.052** (-3.36)	-0.065** (-4.17)	-0.063** (-4.02)	-0.065** (-4.11)	0.169 (5.05)
DIV	-0.0001 (-0.10)	-0.0001 (-0.10)	-0.0001 (-0.10)	-0.0001 (-0.10)	-0.0006 (-0.03)
CI	-0.057** (-12.56)	-0.059** (-12.91)	-0.059** (-12.86)	-0.058** (-12.71)	-0.190 (-11.47)
GDP Growth	0.504** (5.23)	0.592** (6.04)	0.606** (6.07)	0.619** (6.04)	-0.070 (-2.37)
HHI	-0.127** (-5.48)	-0.151** (-6.38)	-0.148** (-6.17)	-0.151** (-6.19)	0.187 (4.83)
Market Share	-0.016 (-0.13)	0.007 (0.05)	0.002 (0.02)	-0.001 (-0.01)	-1.383 (-3.55)
Dummy 1999	-	0.024** (4.95)	0.025** (4.92)	0.024** (4.82)	-0.005 (-2.40)
Dummy 1994	-	-	-0.003 (-0.64)	-0.002 (-0.47)	-0.018 (-5.97)
Dummy 2007	-	-	-	0.005 (0.70)	-0.006 (-2.09)
R-sq	0.04	0.05	0.05	0.05	0.04
Q1 / AR(2)	0.72	0.75	0.75	0.75	0.04
Heter / J	0.88	0.96	0.96	0.96	0.04
Hausman	0.00	0.00	0.00	0.00	-
Notes: The dependent variable is the de-meaned return on assets (ROA). Entries for Models 1 to 4 are coefficient values for equation specification (4.1), where each model differs by the inclusion of an extra dummy variable (D or Dummy) that takes the value zero before the noted date and one afterwards, where the dummy for 2007 represents the					

financial crisis. Model 5 is given by equation specification (4.2) and is the GMM estimation; see discussion and related text (pages 125 and 133). For variable definitions see Table 4.2. Numbers in parentheses are *t*-values robust to autocorrelation and heteroscedasticity. Numbers in brackets are the sum of the coefficients where dummy variables are used. R-sq is the R-squared value of the model, Q1 (AR(2)) is a test of first-order serial correlation (second order for the GMM model). Heter is a test for heteroscedasticity, while J is the Hansen J test for the validity of the instruments in GMM estimation. Hausman is the test for random effects over fixed effects. For these latter three tests entries are *p*-values. * (**) indicates 5% (1%) statistical significance.

An examination of the dynamics of profit and profits persistence is important in understanding the competitive process and the effects of regulatory change and economic upheaval on profit and profit persistence. This, in turn, has implications for the conduct and effectiveness of competition policy and, in particular, whether policies designed to increase competition reduce persistence and thus restore the competitive equilibrium position. Previous results for profit persistence in US banks have provided mixed results, although there is a general consensus that banks typically display a higher level of profit persistence than other non-bank firms within the US. For example, Levonian (1993), Berger et al. (2000) and Goddard et al. (2009 and 2011) all find evidence of a high degree of bank profit persistence. In contrast, Tregenna (2009) and Kanas et al. (2011) for example, report evidence of low persistence in US banking. It is hoped, therefore, that the results in this chapter will contribute to, and provide some clarity in, our understanding of profit persistence in banking and the effectiveness of competition within the banking sector. Furthermore, it is hoped the results here contribute to the debate as to whether deregulation designed to promote increased competition through the two Acts noted above, did indeed lead to decreased profit persistence and thus an enhanced competitive environment.

Using panel estimation techniques, including fixed effects and GMM, the results show that, first, banks exhibit significant positive persistence. Second, that persistence

varies over time with the regulatory changes. Notably, increasing following the 1999 Act and decreasing following the 1994 Act. The existence of significant persistence indicates that, with respect to the competition literature, the competitive equilibrium is not restored instantaneously suggesting impediments to the competitive process. Furthermore, the 1994 Act that allowed for interstate banking, as noted, led to lower profit persistence. This is consistent with the view that this Act did indeed enhance competition, allowing efficient banks to move in to areas previously occupied by less efficient banks that were previously protected from competition. With regard to the 1999 Act, although this would appear to suggest that competitive pressure had eased following the Act, given that profit persistence increased, an alternate view would be that banks were able to protect their profits through the diversification opportunities afforded by the Act. That is, banks were able to gain non-interest based income and thus obtain greater stability in earnings.

With respect to bank specific variables, significant negative relationships were only observed for bank size, bank growth, loans to assets and non-interest expenditure to total income. Therefore, this suggests that if banks grow too large or too quickly, then bank profits decrease as a result of increased inefficiency. As banks become less liquid (i.e. as their loans-to-assets ratio increases) they are less able to respond to changes in market conditions. As non-interest expenditure to total income increases, it follows that banks' costs increase relative to total income, thus reducing bank profit levels. Finally, there is evidence of a positive relationship between HHI and profits. That is, profits tend to be higher with a more concentrated market.

Overall, the legislation designed to enhance competition appears to have had opposing effects on competition in the US banking sector. This suggests that the

outcome in terms of persistence is not always as expected, although this does not necessarily mean that competition has been diminished. Much of the legislation passed in response to the recent financial crisis (for example, the Dodd-Frank Act of 2010) is aimed at maintaining a stable banking sector. A potentially negative outcome of this new legislation however, may be a less effective competitive process within the sector. For instance, the introduction of new barriers to competition arising as a result of an increase in large bank mergers, may once again lead to an increase in the persistence of US bank profit.

Chapter 5. Time-Varying Profit Persistence.

5.1. Introduction.

The impact of both industry and firm characteristics on profits persistence has been extensively analysed (see for example, Schmalensee 1989; Scherer and Ross, 1990; Martin, 2002, for reviews of the empirical literature that seeks to analyse the impact of industry and firm characteristics on profitability). Typically these studies share a common element to the methodology they employ, in that for each firm or industry considered, only one profit persistence measure is estimated for the entire time period. In addition, the explanatory variables used in these models are normally just average values for the time period under consideration. The persistence models used in these studies all have a significant limitation in that they unrealistically assume that persistence is fixed over relatively long periods of time. The methodology commonly applied is the two-step procedure, where time-invariant persistent parameters are estimated for individual firms. In this chapter we estimate an autoregressive specification with interaction effects in the persistence parameters. This allows us to exploit the time dimension of our dataset and thereby enable us to determine more precisely which characteristics, be they industry or bank level, are linked to movement in banks profit persistence.

In common with much of the existing empirical literature examining the persistence of profits whether for industrial firms or banks, the previous chapter estimates a persistence parameter that covers an extended time series period of over twenty years. That said, in a departure from the existing literature, the previous chapter does demonstrate that persistence varies around regulatory changes as well as with the

recent crisis. Thus, the previous chapter begins to break down the unrealistic assumption of a constant degree of profit persistence by allowing discrete shifts arising from regulatory change. As such, the POP approach presented in Chapter 4 is an improvement on static studies. Nevertheless, there are also shortcomings with this approach. Notably, that it retains the assumption that persistence is constant over (sub) periods of time. That is, persistence between these regulatory acts is assumed to remain constant with shifts only occurring in response to a big shock, such as a deregulatory event. However, this assumption remains unrealistic, recalling that the persistence of profits parameter is a proxy for the effectiveness of competitive pressures within the market and given that both banks (and all firms more generally) and markets evolve, we would expect persistence to change more frequently in response to changes in market conditions. Indeed, if we follow the Schumpeterian view of the world where banks (firms) are continually innovating and imitating and so gaining and losing market share and market power, so we would expect competitive pressures to change over time and hence persistence to vary.

A small number of authors have undertaken studies which utilise more refined modelling techniques to examine profit persistence. These include Gschwandtner (2012) who examines how persistence evolves in US industrial firms over three different time periods. Thus, the time-variation in persistence is inferred from the different parameter estimates across the three samples. This could be seen as akin to the analysis in the previous chapter, where the use of dummy variables effectively splits the full sample into sub-samples. Cuaresma and Gschwandtner (2006) and McMillan and Wohar (2011) both consider non-linearity within the persistence of profits equation. Cuaresma and Gschwandtner (2006) estimate a three-regime threshold model, whereby

the parameter in the two outer regimes is equal, while the middle regime follows a random walk process. This is, whether profits are above or below normal persistence is the same, but near normal profits exhibit non-stationary behaviour. McMillan and Wohar (2011) also estimate a threshold model, but they allow the persistence parameter to differ according to whether profits are above or below norm. Thus, they allow the competitive pressures to differ according to whether entry (for above normal profits) or exit (for below normal profits) is the main pressure. Finally, Cuaresma and Gschwandtner (2008, 2013) attempt to directly model time-variation in the persistence of profits parameter. Cuaresma and Gschwandtner (2008) use the Kalman filter approach to estimate either a random walk or autoregressive process for the persistence parameter for six major US firms. While Cuaresma and Gschwandtner (2013) attempt to link persistence to specific firm and industry factors for a panel of US firms. Thus, with the exception of the previous chapter, there has been no attempt to examine time-variation within the persistence of US bank profits.

Therefore, the first aim and contribution of this chapter is to examine whether there is time-variation in the persistence of profits parameter. This is achieved in several ways, including the use of fixed-window rolling and expanding-window recursive regressions based around the first-order autoregressive model. This repeated estimation approach will allow the ability to obtain a time-series of persistence values. A second approach is based around the threshold regression model considered by McMillan and Wohar (2011) whereby a different persistence parameter is obtained according to different regimes of behaviour around several different threshold parameters.

The second aim and contribution of this chapter is to examine which bank specific and market structure factors as well as economic factors, are linked to changes

in banks' profit persistence. This is examined through the use of interaction effects in the persistence parameters of the model. Thus, we link persistence to specific factors in a manner similar to Cuaresma and Gschwandtner (2013), which in turn is based on the general approach of Ferson and Harvey (1991) and Harvey (1991) in a CAPM framework. Furthermore, we also examine whether the linkages between persistence and different bank, market and economic factors may themselves be time-varying. That is, the nature of the relationship between persistence and market concentration, for example, may change over time due to entry and exit and the effect of regulation. It is believed that the results of this chapter, that of whether time-variation exists in the persistence of bank profit, whether that time-variation is linked to specific factors and whether the nature of the relationship with those factors changes over time, will have implications for policy. That is, for example, should bank size or the extent of bank diversification have the effect of increasing persistence thus appearing to hinder the competitive process, this may then give a steer to regulators.

This chapter uses Call Report Data for US banks for the period 1976 to 2009, in order to test the hypothesis that profits persistence is time-varying as opposed to exhibiting discrete changes in response to external shocks such as the implementation of new regulation. In order to do so, we use a variety of techniques including rolling regressions and threshold regressions to establish whether there is time-variation, as well as a regression involving interaction terms to explain the causes of time variation. This will allow us to have a greater understanding of the dynamics of profit persistence. In preview of the main results, we reveal through the fixed and expanding window regressions that there is notable evidence of time-variation within the persistence of profits, which had typically declined over the first part of our sample, before increasing

in the late 1990s and early 2000s and declining once again during the crisis period. The existence of time-variation is further confirmed through a series of threshold-type regressions. In terms of the determinants of time-variation, our results support the view that the variation is linked to bank specific, market structure and economic factors and that furthermore, the strength of these relationships also varies over the sample period. These results have implications regarding how factors such as bank size, market share and market concentration affect competition and demonstrate that there is no simple relationship between, for example, reducing bank size and increasing competition.

Thus, this chapter proceeds as follows; Section 2 reviews the limited literature on time-variation in the persistence of profits parameter. Section 3 examines whether persistence is indeed time-varying using both rolling and recursive plots and threshold estimation. Section 4 considers a model that links persistence to specific factors and examines how those factors vary over time. In addition, the analysis in both Sections 2 and 3 are conducted not only over all banks in the sample but also in sub-samples categorised by bank size. Section 4 summarises and concludes.

5.2. Literature and Modelling Time-Variation.

There has been relatively little work examining time-variation in the persistence of firm profits, although several studies have either directly or indirectly considered possible time-variation. This work has largely focused on documenting changes in profit persistence through a variety of empirical techniques such as using sub-sample analysis, Kalman filter techniques, threshold regressions and variable interaction regressions.

The above work has documented differences in persistence over time. See section 3.8. for a review of the literature on time-variation in the persistence of profits.

5.2.1. Modelling Time-Variation.

Modelling time-variation can be done in several different ways as discussed in section 3.8. Three broad approaches are considered here, two of which are designed purely to identify whether time-variation is present within profit persistence and the third, which both identifies whether time-variation exists as well as the causes of such variation.

A relatively straightforward approach to examine whether there is time-variation in bank profit persistence (or indeed any series of interest) is to consider the use of rolling (fixed-window) and recursive (expanding-window) regressions. That is, an initial sample is selected of, say, five years ($t_0...t_4$) and the estimated persistence parameter obtained. Under a fixed window rolling scheme this five-year sample is moved one observation ($t_1...t_5$) and a new estimate of persistence obtained. Under the expanding window recursive approach the start of the sample is held fixed and one observation added to the end of the sample, which thus increases in size ($t_0...t_5$). This process continues until the end of the sample and produces a time series of persistence values. Rolling and recursive regressions, although relatively simple in construction, have been used in a variety of contexts to examine time-variation and often to detect the presence of structural breaks. For example, Benerjee et al, (1992) introduced rolling and recursive tests for the presence of a unit root in time-series data. With respect to structural break testing Pesaran and Timmerman (2007) consider regression windows of different lengths to forecast a series post-break, while Giacomini and White (2006)

advocate rolling regressions in this context. Rolling regressions also underlie the structural break methodology of Bai and Perron (1998). Rolling regressions have also been used to illustrate and examine time-variation in different setting, such as time-varying CAPM (e.g., Fama and French, 1997; Ang and Chen, 2007), international stock market correlations (e.g., Goetzmann et al, 2001) and stock return volatility (e.g., Mikosch and Stărică, 2004).

An alternative way to examine whether there is time-variation within the series is to consider some simple regime-switching (threshold) regressions. While threshold models (Tong, 1983) have a large literature of their own (see the concise review by Hansen, 2011), it should be noted that the purpose of these regressions here is to examine whether persistence varies over time and not to obtain a specific data generating process around a non-linear function. Furthermore, as it is the contention here that the cause of the time-variation could be across bank specific, market structure and economic conditions and that this is something that could not be examined in a single non-linear setting, nonetheless, evidence of non-linearity would support the presence of time-variation and thus we consider a selection of simple threshold models following McMillan and Wohar (2011). Thus, we estimate the following:

$$\pi_{it} = \alpha_0 + \beta_1 \pi_{it-1} I_t + \beta_2 \pi_{it-1} (1 - I_t) + \varepsilon_{it} \quad (5.1)$$

where $I_t = 1$ if $z_{t-1} > 0$ and zero otherwise, where z_t is the threshold variable that takes one of four forms in the analysis below. In particular, following an autoregressive approach, we first consider lagged profits for the threshold variable. Second, the annual growth rate of GDP is used as the switching variable. Third, as it is the contention here that a combination of variables truly lies behind time-variation, the fitted value from a

linear profits equation, similar to that of equation (4.1) in Chapter 4, is taken. Finally, the degree of bank diversification, through the ratio of non-interest income to total income is considered as the threshold. The choice of threshold variables is slightly ad hoc and the main purpose is to be illustrative and not to determine the best fitting model. Nonetheless, the choice of threshold variable can be rationalised, for example, the use of the lagged dependent variable (profits) is common within non-linear modelling (the resultant model is often referred to as a self-exciting threshold regression), see, for example, McMillan and Wohar (2011). The use of lagged GDP growth would be consistent with the belief that competitive pressures and persistence will differ according to whether the economy is expanding or contracting. Given that profits exhibit pro-cyclical behaviour and risk counter-cyclical behaviour, then market conditions are likely to differ across the business cycle. The choice of non-interest income to total income is just one measure of the bank specific variables that could be considered, but seems reasonable in that we would expect more diversified firms to have greater profit persistence than less diversified firms. Indeed, the argument in favour of diversification is to reduce exposure to a shock effecting one aspect of the banks business.⁹ Finally, using the fitted value from the profits regression is a (rough) way of incorporating information from all variables into the threshold regression. This is pertinent to the belief that time-variation will arise from several sources. Furthermore, in the empirical analysis below, a value of zero is imposed for the threshold point. In principle, this value could be estimated; however, as this exercise is purely to illustrate the possible presence of time-variation, a value of zero is sufficient.

⁹ As noted above, this variable is only available over the shorter sample period, nonetheless we include it here as we believe diversification may be a relevant variable for profit persistence.

The main model estimated in this chapter in order to examine the determinants of time-variation within profit persistence is based on that used by Cuaresma and Gschwandtner (2011). Here the authors propose a simple generalisation of the first-order autoregressive process used to examine the persistence of profits given by the following equation:

$$\pi_{i,t} = \alpha_i + \lambda_i \pi_{i,t-1} + \varepsilon_{i,t} \quad (5.2)$$

where λ_i is the short run persistence parameter, and $\varepsilon_{i,t}$ is a white noise disturbance term. The long run projected profit rate for firm i is given by $\pi_i^* = \alpha_i / (1 - \lambda_i)$. Under the hypothesis of perfect competition, the long run projected profit rates would be zero, however as many empirical studies have shown, there appears to be significant differences in π_i^* across firms.

Following methodology used by Cuaresma and Gschwandtner in order to examine the potential determinants of the differences in short and long run profit persistence, we estimate the following equation

$$\pi_{i,t} = \alpha(X_{i,t}) + \lambda(Z_{i,t})\pi_{i,t-1} + \varepsilon_{i,t} \quad (5.3)$$

Where α_i and λ_i are assumed to be functions of a set of economic variables $X_{i,t}$ and $Z_{i,t}$ respectively. Estimating this equation therefore allows us to examine both the impact of changes in the variables on short-run persistence, by studying the effects of changes in $Z_{i,t}$ on $\lambda(Z_{i,t})$; and the impact of changes in the variables on long-run persistence, by analysing $\alpha(X_{i,t})/[1-\lambda(Z_{i,t})]$.

The econometric specification of this equation is given by the following:

$$\pi_{i,t} = \alpha_0 + \sum_{i=1}^{\bar{x}} \alpha_i x_{i,t} + (\lambda_0 + \sum_{i=1}^{\bar{z}} \lambda_i z_{i,t}) \pi_{i,t-1} + \varepsilon_{i,t} \quad (5.4)$$

in which it is assumed that the $\alpha(\cdot)$ and $\lambda(\cdot)$ functions are linear on $X_{i,t}$ and $Z_{i,t}$ respectively. Cuaresma and Gschwandter use the following firm characteristics to explain profit persistence: market share (MS), the volatility of the profit rate (RISK), the size of the company (as measured by the value of assets, ASSETS) and the growth rate of the company's sales (GRSALES). The industry characteristics used are concentration (in this case the percentage of industry output produced by the 4 largest firms in the industry, CR4), size (the number of firms in the industry, NFIRM, and the value of shipments, VS) and finally the growth of the number of firms.

The series of bank and market specific variables used in our model, as well as output (GDP) growth which was obtained from the US Bureau of Economic Activity Website), are the same as those used in Chapter 4. These include measures for bank size, growth and market share (based on total assets), capital structure or leverage (based on the equity-to-assets ratio) and liquidity (based on the loans to assets ratio). In this chapter we also make use of the HHI (Herfindahl-Hirschman index) measure based on total assets as calculated in the previous chapter. In order to maximise the time series element of the data set for the main regressions below we do not include those variables from Chapter 3 that are only available over the shorter time period of 1984-2009. This includes the measures of diversification (non-interest income to total income) and costs (non-interest expenditure to total income). As in Chapter 4, the model is estimated using a fixed effects panel approach.

5.3. Hypotheses, Data and Evidence of Time-Variation in the Persistence of Profits.

The aim of this section is to set out the key hypotheses of this chapter and to consider whether there exists any evidence, within our data, for time-variation in the persistence of profits. The first hypothesis and the aim of the remainder of this section is that time-variation does exist. The second hypothesis, which is the focus of the following section, is that such time-variation is linked to specific factors. The underlying belief is that time-variation in profit persistence occurs as banks and markets evolve over time due to product innovation, merger and takeover activity, changes to regulation and economic shocks. That is, as bank size and market share changes, or as the market structure changes, or as economic conditions change.

Time-variation, of course, can mean several different things depending on the context of the data. The underlying belief in this chapter is that profit persistence varies over time and that such variation depends upon bank specific factors, market structure factors and economic conditions and thus is not merely due to parameter instability in specific sub-samples of the data. Time-variation in the persistence of profits can also arise from structural breaks, such as economy shocks or changes in regulatory environment. Again, it is the contention of this chapter, that while such breaks can and do occur, there also exists less abrupt time-variation arising from evolving bank, market and economic conditions. Inevitably, this will include the regulatory environment and adjustment processes to external shocks, but will also include more fluid characteristics. Furthermore, the nature of those characteristics may be less easy to identify or define for policy makers. Indeed, the key distinction between this chapter and Chapter 4, which examined the impact of two key regulatory changes on persistence, is that the objective of Chapter 4 was to examine the effect of regulation aimed at enhancing

competition on persistence, and by implication, the degree of competition. Thus, Chapter 4 measures the impact of regulation. The aim of this chapter is to examine the different factors that may cause time-variation within persistence and how that evolves over time. Nonetheless, it may be that the nature of any factor's influence on persistence may guide future regulatory changes. Finally, with respect to approaches to time-variation, non-linear dynamics within the profits equation could cause persistence to vary across time. In this context, such variation would be linked to a specific variable or process that alters the regime of behaviour. For example, Crespo Cuaresma and Gschwandtner (2006) and McMillan and Wohar (2011) examined how persistence varied according to the level of profit relative to the norm. Again, while we contend that these factors may be important, it is also our belief that time-variation is the result of different interacting factors, rather than a single regime-switching variable.

The data set used in this chapter is the same as that discussed in Chapter 4; that is, all the data is collected from the fourth quarter call reports (Report of Condition and Income) available from the Chicago Federal Reserve Website. In particular, we obtain the profit persistence measures using both return on assets (ROA) and return on equity (ROE). Again, the full set of data for these measures extends from 1976 to 2009. In addition to these profit measures, we have a series of bank and market specific variables as well as output (GDP) growth (which was obtained from the US Bureau of Economic Activity Website). As in Chapter 4, the bank and market specific variables include measures for bank size, growth and market share (based on total assets), capital structure or leverage (based on the equity-to-assets ratio) and liquidity (based on the loans to assets ratio). In this chapter we also make use of the HHI (Herfindahl-Hirschman index) measure based on total assets as calculated in the previous chapter. In

order to maximise the time series element of the data set for the main regressions below, we do not include those variables from Chapter 4 that are only available over the shorter time period of 1984-2009. This includes the measures of diversification (non-interest income to total income) and costs (non-interest expenditure to total income).

To provide an initial examination of whether there is indeed time-variation in bank profit persistence, we first consider rolling (fixed-window) and recursive (expanding-window) regressions. As noted above, the purpose of the rolling and recursive regressions in this context is to examine whether the persistence series exhibits time-variation and not to test for breaks. Thus, we proceed with a graphical analysis of our data. Figure 5.1 presents the rolling profits (ROA) persistence parameter, i.e., the λ from equation (5.2), estimated using a fixed effects regression over all the banks in the sample, with the rolling fixed window set at five years. Figure 5.1 also presents a similar exercise based on a recursive expanding window. Evident in both of these figures is that persistence has undergone a noticeable amount of time-variation over the sample period. In particular, there is noticeable evidence that persistence declined during the second half of the 1980s. During much of the 1990s, persistence fluctuated in a cyclical pattern around a relatively constant and low level. However, in the late 1990s and early 2000s persistence increased and quite dramatically so; indeed on the rolling graphs, persistence became larger than at any previous point during the sample. Finally, persistence fell at the end of the sample. In trying to explain these movements, we note that Stiroh and Strahan (2003) argued that deregulation undertaken during the 1980s increased competitive pressures in the banking market which could therefore explain the decline in profit persistence. Equally, and in accordance with Chapter 4, there is a small decline in persistence after 1994 and the interstate branching act. The large increase in

persistence from around the end of the 1990s and start of the 2000s, is consistent with the introduction of universal banking and ability for banks to diversify into other areas in order to stabilise earnings. Finally, the financial crisis that began in 2007 saw profit persistence decline dramatically. Both of these latter two points also confirm the findings of Chapter 4.

To further examine time-variation within profit persistence, we reconsider the above two exercises but this time separate the banks in to size quartiles based on total assets. We do this in order to examine whether the overall results in Figure 5.1 are driven by only a subset of the data (e.g. big banks) or whether the time-variation is common to all size strata of banks. Therefore, Figure 5.2 presents the rolling persistence coefficients for small, below median, above median and large firms; while Figure 5.3 presents the same information but based upon recursive regressions. Evident within these two figures is that the persistence of profits between small and large banks differs from that found for medium-sized banks. In particular, small and large banks follow the general pattern reported for all banks above, albeit with less evidence of a decline in persistence due to the financial crisis. But elsewhere the patterns are similar, with a decline in persistence in the late 1980s and a rise in persistence in the late 1990s and early 2000s. Medium sized banks, in contrast, have generally seen a decline in persistence throughout the entire sample. This is most noticeable for banks sized above the median (quartile three). A possible explanation for this occurrence is because this particular group of banks may have been squeezed by the dominance of larger banks.

Figures 5.4 and 5.5 present the same rolling and recursive estimates for all banks and by bank size, but this time using ROE as the measure of profits. The patterns observed in persistence basically follow the same shape as reported for ROA profits

Figure 5.1. Rolling and Recursive Persistence - All Banks



Left Hand Scale presents the series values

Bottom Scale represents time period

Figure 5.2. Rolling Persistence Valuesby Bank Size



Left Hand Scale presents the series values

Bottom Scale represents time period

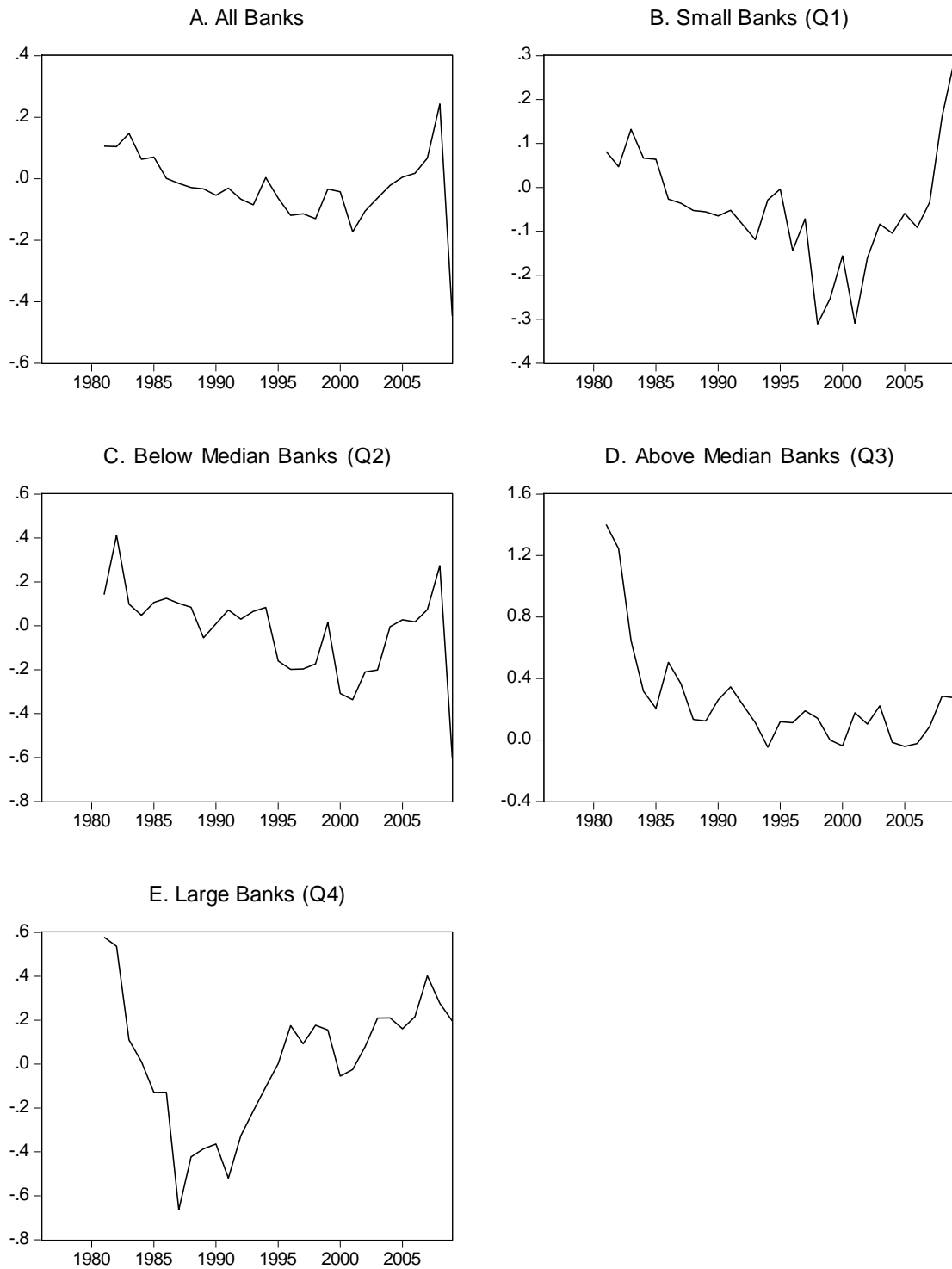
Figure 5.3. Recursive Persistence by Bank Size



Left Hand Scale presents the series values

Bottom Scale represents time period

Figure 5.4. Rolling Persistence - ROE



Left Hand Scale presents the series values

Bottom Scale represents time period

Figure 5.5. Recursive Persistence - ROE



Left Hand Scale presents the series values; Bottom Scale represents time period

above. In particular, there is a decline in persistence during the late 1980s (more noticeable with the rolling regressions), followed by an increase in persistence in the late 1990s and early 2000s. Further, the general pattern found for all banks is most replicated in the graphs for both small and large banks, while medium banks appear to have declining persistence for most of the sample.

An alternative way to examine whether there is time-variation within the series is to consider the threshold regression approach. As such, four versions of the simple threshold regression (TR) model used in McMillan and Wohar (2011) are considered. Table 5.1 reports the results of the threshold model for all banks using the four alternate threshold variables. Evident from Table 5.1 is that there is significant statistical evidence for time-variation within the persistence parameter, such that it differs according to the state of the threshold variable. With respect to lagged profits, however, there is no statistical evidence of asymmetry in the model and hence time-variation. That is, although the magnitude of the coefficient is slightly higher in the negative profits regime it is both similar in value to the positive profits regime but crucially not significantly different. Notwithstanding that, for the remaining three measures there is evidence of a statistical difference between the parameter estimates across the two regimes. Furthermore, for each of GDP growth, fitted profits and the ratio of non-interest income to total income, the positive regime coefficient is greater than the negative regime coefficient. This is most noticeable for the non-interest income threshold variable, but applies to all three. Therefore, profits persistence appears higher when GDP growth is positive, such that the economy is expanding. Profits persistence is also higher when fitted profits is positive, hence, it could be argued that competitive

pressures are more pressing when profits are below norm.¹⁰ Finally, profit persistence is higher, the greater the degree or level of non-interest income as a ratio of total income, and thus the greater the degree of diversification. From an economic standpoint these results appear broadly consistent with what one would expect; that banks are able to sustain profits better in a growing economy, when profits are high and when they are well-diversified. With regard to the specification tests, the R-squared value remains relatively low (as also reported in Chapter 4), while the residual autocorrelation test is passed for three models at the 5% level but not for the fitted threshold model.

Table 5.1. Threshold Regressions – All Banks					
Threshold Variable	β_1	β_2	Wald Test	R-squared	Q1
Lagged Profit	0.181 (6.13)**	0.218 (3.65)**	0.30 (0.58)	0.09	0.38
Lagged GDP Growth	0.191 (7.09)**	0.125 (2.01)*	5.72 (0.02)*	0.04	0.13
Lagged Fitted Value	0.243 (23.73)**	0.195 (11.73)**	4.25 (0.04)*	0.08	0.04*
Lagged Non-Int Inc	0.218 (5.30)**	0.072 (1.34)	4.77 (0.03)*	0.05	0.09
Notes: Entries are coefficient values and autocorrelation and heteroscedasticity robust <i>t</i> -statistics in parentheses of equation (5.1), where bank profits are assumed to follow a threshold autoregression of order one. The first column represents the threshold variable, which in turn is, lagged profit, lagged output growth, the lagged fitted value from the profits equation from Chapter 4 and lagged non-interest income. The second column is the coefficient value when the threshold variable takes a positive value. The third column is when the threshold variable takes a negative value. The Wald test, in the fourth column, is for the equality of the two slope parameters, i.e., $H_0: \beta_1 = \beta_2$, with resulting <i>p</i> -values in parentheses. The regressions are conducted over the period 1984-2009 for all banks in the sample. * (**) denotes 5% (1%) statistical significance. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test.					

¹⁰ Note that this is similar to the results for UK industrial firms in McMillan and Wohar (2011), although differs from the first results in Table 1. This may be due to the inherent smoothing that takes place in obtaining the fitted value from a regression.

Table 5.2 presents the same results but separates banks according to their size based on total assets; thus, four quartiles are generated. From this analysis we can see that there are noticeable differences between profit persistence, bank size and the causes of time-variation. With respect to small firms (quartile 1), in terms of the threshold models, the only threshold variable which exhibits significant evidence of asymmetry (and thus time-variation), is the non-interest income as a ratio to total income. Furthermore, the coefficient in the positive regime is greater than the coefficient in the negative regime, supporting the view that more diversified banks have a higher degree of profits persistence. With respect to small-medium sized banks (quartile 2) all the threshold regressions exhibit statistically significantly different coefficients across the two regimes. Furthermore, for each of these four threshold regression, the coefficient associated with the positive regime is greater than the coefficient associated with the negative regime. Therefore, persistence is higher with higher profits, higher GDP growth and greater diversification. For medium-large banks (quartile 3) there is a noticeable difference with only fitted profits as the threshold indicating a significant difference in coefficients across the two regimes. However, again, it is the coefficient associated with the positive regime that is greater. Finally, for big banks (quartile 4) we do notice a difference in how persistence behaves over the regimes. Statistical differences in profits persistence are noted for the fitted profit and non-interest income threshold variables. However, what is noticeable is that persistence is now higher in the negative regimes. That is, for banks in this category, profit persistence is lower when profits are above the norm and when the degree of diversification is higher than average. This may be consistent with the view that large banks may have a tendency to over-diversify, or to take on greater risk and as such profits exhibit less persistence or

faster mean-reversion. In terms of the specification tests, we can see that the R-squared values for these size categories are higher than for all banks but that the residuals fail the serial correlation test, indicating that perhaps longer lag lengths are required.

Table 5.2. Threshold Regressions – By Bank Size					
Threshold Variable	β_1	β_1	Wald Test	R-Squared	Q1
Small Banks (Quantile 1)					
Lagged Profit	0.018 (0.36)	0.048 (0.39)	0.05 (0.83)	0.14	0.01*
Lagged GDP Growth	0.024 (0.49)	-0.17 (-0.7)	0.59 (0.44)	0.16	0.03*
Lagged Fitted Value	0.043** (6.05)	0.041** (2.37)	0.01 (0.91)	0.61	0.04*
Lagged Non-Int Inc	0.118 (1.32)	-0.15 (-1.5)	4.08* (0.04)	0.10	0.01*
Below Median Banks (Quantile 2)					
Lagged Profit	0.874** (32.3)	0.177** (3.88)	164.3** (0.00)	0.59	0.03*
Lagged GDP Growth	0.688** (29.2)	0.397** (4.01)	8.48** (0.00)	0.59	0.01*
Lagged Fitted Value	0.853** (33.8)	0.212** (5.04)	167.7** (0.00)	0.47	0.04*
Lagged Non-Int Inc	0.846** (25.3)	0.287** (5.35)	79.38** (0.00)	0.32	0.01*
Above Median Banks (Quantile 3)					
Lagged Profit	0.487 (1.88)	0.069 (0.44)	1.71 (0.19)	0.42	0.03*
Lagged GDP Growth	0.183 (1.40)	0.324 (0.68)	0.09 (0.77)	0.42	0.03*
Lagged Fitted Value	0.332** (24.1)	0.083** (10.1)	231.7** (0.00)	0.83	0.01*
Lagged Non-Int Inc	-0.11 (-0.5)	0.340 (1.66)	2.40 (0.12)	0.28	0.01*
Large Banks (Quantile 4)					
Lagged Profit	0.254** (4.58)	0.351** (5.82)	1.25 (0.26)	0.52	0.04*
Lagged GDP Growth	0.292** (7.33)	0.382** (2.72)	0.39 (0.53)	0.52	0.03*
Lagged Fitted Value	0.267** (25.2)	0.302** (26.26)	4.89* (0.03)	0.50	0.04*
Lagged Non-Int Inc	0.196** (8.41)	0.369** (13.2)	23.43** (0.00)	0.040	0.02*
Notes: Entries are coefficient values and autocorrelation and heteroscedasticity robust <i>t</i> -statistics in parentheses of equation (5.1), where bank profits are assumed to follow a threshold autoregression of order					

one. The first column represents the threshold variable, which in turn is, lagged profit, lagged output growth, the lagged fitted value from the profits equation from Chapter 4 and lagged non-interest income. The second column is the coefficient value when the threshold variable takes a positive value. The third column is when the threshold variable takes a negative value. The Wald test, in the fourth column, is for the equality of the two slope parameters, i.e., $H_0: \beta_1 = \beta_2$, with resulting p -values in parentheses. The regressions are conducted over the period 1984-2009 for all banks in the sample. * (**) denotes 5% (1%) statistical significance. Q1 is the p -value for a first-order residual autocorrelation test.

Overall, the aim of this section was to examine the hypothesis that there is time-variation in profit persistence. The examination of this issue was achieved in two ways; first, by considering fixed window rolling and expanding window recursive plots, second, by considering some simple threshold regressions. Furthermore, the analysis was conducted on all banks in the sample but was also considered on bank size quartiles. The results do indeed suggest evidence of time-variation. Both the rolling and recursive plots reveal substantial movements in the persistence parameter, with a noticeable decline in persistence from the late 1980s and an increase in persistence from the late 1990s and early 2000s, before exhibiting a decline associated with the financial crisis. This is largely replicated across the different size categories of banks, albeit with individual nuances. The exception to this is quartile 3 (above median, medium-large) banks, where persistence fell in the late 1980s and remained low. This perhaps suggests that this category of banks have experience greater pressure on profits. Evidence from the threshold regressions also supports time-variation as there are a number of significant models whereby the parameters above and below the threshold variable are statistically different. Furthermore, and in general, the positive regime coefficient is greater than the negative regime coefficient, suggesting the persistence is higher with above normal profits, positive GDP growth and above average degree of diversification. The only key exception to this is for large banks where persistence is higher in the negative regime when using fitted profits and diversification as the threshold variables.

Taken together with the evidence from the previous chapter, we proceed to examine what factors may explain the time-variation.

5.4. Results from Modelling Time-Variation.

The previous section highlighted the presence of time-variation in bank profit persistence. Thus, the aim of this section is to examine which factors may contribute to the time-variation. In order to do this we follow the general approach considered by Cuaresma and Gschwandtner (2013) but which dates back to Harvey (1991). We begin with the usual fixed effects regression as considered in Chapter 4:

$$\pi_{it} = \alpha + \gamma_i + \lambda \pi_{i,t-1} + \sum_{j=1}^J \beta_j x_{jit} + \sum_{k=1}^K \delta_k z_{kit} + \sum_{p=0}^P \theta_p \Delta y_{t-p} + \sum_{i=1}^2 \kappa_i D_i + \varepsilon_{it}; \quad (5.5)$$

Where π_{it} represents the profitability of bank i at time t and $\pi_{i,t-1}$ is lagged profitability, which measures the degree of persistence. Contained within the vector x_{jit} is a set of J exogenous variables that related to bank specific behaviour. Similarly, contained within the vector z_{kit} is a set of market related variables, while Δy_t represents the change in annual GDP. The D_i terms relate to dummy variables that may affect bank profits following regulatory changes in 1994 and 1999; equally, a dummy is included for the crisis period. A common constant for all observations is denoted by α , while the fixed (bank-specific effects) are given by γ_i . Finally, ε_{it} represents the random error term.

As noted above, we believe that persistence, λ is time-varying and thus could be written as:

$$\lambda_t = \mu + \sum_{n=1}^N \varphi_n x_{jt} + \sum_{k=1}^K \psi_k z_{kt} + \sum_{p=0}^P \zeta_p \Delta y_{t-p} + u_{it}. \quad (5.6)$$

That is, we believe the persistence itself depends upon bank specific, market structure and economic variables. However, the time-varying λ is not observable; hence we substitute equation (5.6) into equation (5.5):

$$\begin{aligned} \pi_{it} = & \alpha + \gamma_i + \lambda \pi_{t-1} + \sum_{n=1}^N \lambda_n \pi_{t-1} x_{nit} + \sum_{k=1}^K \lambda_k \pi_{t-1} z_{kit} + \sum_{p=0}^P \lambda_p \pi_{t-1} \Delta y_{t-p} \\ & + \sum_{j=1}^J \beta_{ji} x_{jit} + \sum_{k=1}^K \delta_{ki} z_{kit} + \sum_{p=0}^P \theta_p \Delta y_{t-p} + \sum_{i=1}^2 \kappa_i D_i + \varepsilon_{it}. \end{aligned} \quad (5.7)$$

Table 5.3 reports the results of estimating equation (5.7) for all banks over the sample period.¹¹ In addition, we also split the sample into four roughly equal subsamples, as we believe the different factors may have different impacts on persistence over time due to, for example, regulatory changes. Further to this, we also report in Tables 5.4-5.7 the same results where banks are separated by size according to total assets. In estimating these models the bank specific factors are bank size, growth, equity-to-assets ratio, loans-to-assets, market share and the change in market share. The market structure factors are the change in the number of banks, market concentration as proxied by the HHI and the change in HHI. The economic factors are current and one period lagged annual GDP growth. These factors differ slightly from those in the previous chapter to ensure the longest possible time-series available. Furthermore, as we are examining time-variation in persistence, we include the change in two key measures; market structure, which effectively represents the success of the bank's operations, and HHI, the degree of market concentration. That is, we believe the dynamic of profit persistence will depend upon the dynamics of these variables as well as their levels.

¹¹ For ease of presentation, we only report the interaction terms.

The results in Table 5.3 suggest that all three general factors, bank specific, market structure and economic, play a role in determining the time-varying persistence of bank profit. Furthermore, the nature and strength of that role changes through time. Examining the column that represents the full sample, we can see that bank specific factors are important, with market share, growth and loans-to-assets ratio all having a negative impact, while equity-to-assets ratio and size has a positive effect. With respect to market structure, the change in the number of banks has a small positive effect, while the change in concentration (HHI) has a negative effect. Finally, GDP growth has a positive effect on persistence, although with a lag. Before trying to provide a rational for effects, we can see in the remaining columns of results that there is noticeable time-variation in the factors that cause time-variation in persistence. In the period between 1976 and 1983 we can see that market share had a positive effect on persistence, while in the remaining periods the effect was either negative or not significant. Regarding the change in market share, the effect was negative over the period 1976-1983 but positive over the period 1984-2000. One argument that could be made here is that in the earlier period there were restrictions on bank activity and the extent to which they could expand. Thus, market share could change as the number of banks changes. However, in the latter periods, which allowed inter-state banking, the change in market share could be seen as the outcome of bank strategy. With regard to other bank specific characteristics, we can see that bank size always has a positive relationship with persistence, while growth always has a negative relationship. The equity-to-assets ratio typically has a positive coefficient. Thus, as banks have higher amounts of equity and lower debt, so persistence increases. Banks with lower debt ratios (higher equity) would typically be seen as safer. Furthermore, debt capacity could allow them to grow quickly

if needed. The only exception to this is during the period 1984-1991, this is when deregulation began and it may be banks used lower equity ratios to capture market share. Finally, the loans-to-assets ratio, as a proxy for liquidity, has a positive relationship over the first half of the sample, whereby more banks with large loan portfolios had higher persistence. However, this changed to negative such that more liquid banks have higher persistence as they could be regarded as being more flexible. With regard to the market structure variables, the number of banks has a small and positive effect throughout the sample period. The variable relating to market concentration (HHI) is typically negative. As such, a higher degree of market concentration and less banks leads to a lower degree of profit persistence. Where less banks and greater concentration may suggest a lower degree of market competition, this suggests that less competition may lead to more risk-taking and hence more volatile profits; or it may lead to complacency and lower efficiency. One exception to this is the period 1984-1991, where market concentration had a positive relationship. This is also a period in which deregulation began. Indeed, this result could be seen as consistent with the observation of Stiroh and Strahan (2003) where less efficient banks were being pushed out by more efficient banks, thus the greater concentration here came with higher profits. Finally, GDP growth has a positive effect on profit persistence, although this is sometimes with a lag.¹² Regarding the specification tests, we can see that for the sub-samples the model explains a reasonable amount of the movement in profit. However, it is noticeable that the explanatory power of the model is reduced in the period that covers the financial

¹² As noted above we did not include in this regression the measure of diversification as it is only available over a short time series (from 1984). Nonetheless, when including this variable it is statistically significant and positive. That is, persistence is higher with a more diversified bank. This result is consistent with the view that a more diversified bank that has greater income streams can in part insulate itself from a shock to one such earnings stream.

crisis. Each model passes the first-order residual serial correlation test, although again for the crisis period there is some marginal evidence for such correlation.

Table 5.3. Time-Varying Persistence – All Banks					
	All	1976-1983	1984-1991	1992-2000	2001-2009
Profit(-1)	-0.698** (-8.28)	-0.590** (-14.29)	-0.617** (-11.18)	0.013 (0.17)	-0.986** (-2.71)
*Mkt Share	-3.644** (-3.24)	3.23** (5.12)	-2.034** (-3.09)	0.452 (0.76)	-11.626* (-2.24)
*Ch. Mkt. Sh	1.179 (0.699)	-13.98** (-4.60)	16.028** (8.03)	6.16** (4.88)	1.89 (0.36)
*HHI	0.010 (0.13)	-0.472** (-6.65)	0.965** (7.17)	-0.497** (-14.49)	0.306 (0.86)
*Ch. HHI	-0.688** (-5.05)	-0.501 (-1.42)	5.353** (9.49)	-0.266* (-2.06)	-0.995** (-2.56)
*Ch. GDP	-0.707 (-1.26)	2.232** (13.47)	4.679** (13.95)	-2.035** (-2.57)	-0.282 (-0.09)
*Ch. LGDP	5.959** (10.06)	2.459** (17.80)	-4.268** (-6.75)	16.129** (40.49)	7.751** (2.81)
*Ch. No. Bks	0.001** (16.40)	0.001** (4.65)	0.002** (4.72)	0.001** (23.79)	0.002 (1.29)
E/A	0.011 (2.31)	1.807** (38.68)	-0.399** (-23.13)	0.055** (2.52)	0.010 (0.87)
*Size	0.117** (13.48)	0.037** (9.47)	0.079** (13.71)	0.028** (4.24)	0.128** (3.67)
*Growth	-0.464** (-32.77)	-0.143** (-12.12)	-0.467** (-44.67)	-0.589** (-76.41)	-0.416** (-8.72)
*L/A	-0.219** (-5.35)	0.221** (8.65)	0.108** (4.10)	0.024 (0.89)	-0.495** (-2.59)
R-squared	0.09	0.57	0.45	0.52	0.14
Q1	0.10	0.12	0.24	0.14	0.08
Notes: Entries are coefficient values (<i>t</i> -statistics in parentheses) for equation (5.7), where bank profits are regressed on lagged bank profits and the interaction terms given by: Mkt Share is market share by total assets, HHI is the Herfindahl-Hirschmann Index, GDP is gross domestic product, E/A is the equity-to-assets ratio, Size is given by total assets, growth is the change in total assets, L/A is the loans-to-assets ratio, Ch represents the change and L the natural logarithm. These terms are also entered in the regression individually but are not reported. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test. * (**) denote 5% (1%) statistical significance.					

Tables 5.4 to 5.7 present the same results but for banks separated by size according to their total assets. Before examining the individual coefficient values we can look at the specification tests. It is noticeable that the explanatory power of the model varies across the sample both temporally and in terms of bank size. Of particular interest is that the period including the financial crisis has higher explanatory power for the separate groups of banks than for other periods. This could arise as banks of similar size were affected similarly and hence the model is able to capture this behaviour. We also, again, report tests for first-order residual correlation, which is the key test when trying to understand the temporal nature of the data. The models suggest no remaining such correlation although the test only passes marginally in some cases.

Table 5.4 presents the same results but this time for small banks only (quartile 1). In comparison with the all banks results in Table 5.3, while we can see some similarity in the results, there are also noticeable differences. With regard to market share and change in market share, it is apparent that over the full time sample the effects are negative, suggesting that profits change as market share is gained or lost. The negative effect appears in most sub-samples, although as with all banks, we see a positive coefficient for market share in the earliest part of the sample when banking restrictions were strongest and a positive effect with the change in markets share during the 1980s when deregulation began. As with all banks, growth always has a negative effect, while size always has a positive effect (with the exception of the 1976-1983 time period). Similarly, the loans-to-assets ratio has changed from positive at the beginning of the sample to negative. As with all banks this suggests that profit persistence was affected positively by having a large loan portfolio at the beginning of the sample but positively by having a higher degree of liquidity at the end of the sample. Capital

structure, through the equity-to-assets ratio has a negligible effect over the full sample, albeit the response is similar to all banks in the first two sub-periods. That is positively in the first sub-period and negatively in the second. With regard to the market structure variables, again the number of banks typically has a positive relationship (except in the period 1984-1991 where it is not significant). For market concentration, the effect here is positive in the second half of the sample, although the change in concentration is negative. This latter result is the same as for all banks, suggesting that increases in concentration are associated with lower persistence, but a higher overall level of concentration leads to higher persistence, in contrast to all banks. It may be at this end of the market, more concentration may lead to greater stability and less volatility in profits. As before, the effect of GDP growth is positive, although the lagged effect is more pronounced.

Table 5.5 presents the results of equation (5.7) but this time just for small-medium banks (quartile 2). In comparison with the all banks results in Table 5.3, again while we see some similarity in the results, there are also some differences. With regard to market share and change in market share, this variable is now predominately insignificant in the sub-samples, although over the full sample, we can see that the level of market share has a positive effect and the change in market share a negative effect. From the sub-samples, we can see that this predominantly comes from the 1984-1991 period, which is associated with the start of deregulation. With respect to other bank specific variables, as with the previous results from all banks and small banks, there is a negative effect from growth (albeit with the exception of the 1984-1991 period) and again we see the effect of the loans-to-assets ratio change from positive at the start of the periods to negative by the end of the sample. However, in contrast to previous

results, we now see the effect on size as being negative, such that the larger banks in this category have lower profit persistence. As before, the equity-to-assets ratio is positive over the same period but exhibits less significance in the sub-samples. Thus, as with small banks, the effect of capital structure is more subdued than reported for all banks. With regard to the market structure variables, there is no significant effect in the first sub-period, but subsequent to that the level effect is negative but the change is positive over the period 1984 to 2000. In the final sub-period, the level effect becomes positive. This supports the view that greater levels of concentration lowered persistence for this category of bank, although changes in market concentration had a positive effect. Again the number of banks typically has a positive relationship (except in the period 1984-1991 where it is not significant). These results suggest that this category of bank, higher market concentration, in conjunction (in part) with higher market share may have led to complacency or some other behaviour that subsequently resulted in lower profit persistence. It can also be seen in the rolling and recursive plots that for the middle two quartiles persistence declined during the 1980s and did not increase in the way that persistence rose for small and large banks. Finally, we can see that GDP growth has a positive effect over the first half of the sample, but the effect is mixed thereafter.

Table 5.4. Time-Varying Persistence – Small Banks (Quantile 1)					
	All	1976-1983	1984-1991	1992-2000	2001-2009
Profit(-1)	-0.166** (-17.75)	0.050 (0.47)	-0.198 (-1.19)	-0.426** (-17.36)	-0.470** (-6.38)
*Mkt Share	-18.617** (-5.56)	43.691** (3.16)	-13.514** (-3.64)	-10.610** (-8.03)	30.378 (1.08)
*Ch. Mkt. Sh	-29.943** (-5.96)	-57.817** (-6.62)	52.850** (3.41)	-20.692** (-16.48)	23.635 (0.86)
*HHI	0.337** (5.17)	-0.574** (-5.43)	0.163 (0.58)	0.351* (2.20)	2.096** (6.54)
*Ch. HHI	-1.569** (-8.48)	1.020* (1.96)	11.86** (9.02)	-1.509** (-5.11)	-2.915** (-6.31)
*Ch. GDP	-1.114** (-2.57)	3.314** (12.40)	11.270** (15.30)	-2.233 (-1.23)	3.601 (0.93)
*Ch. LGDP	6.203** (14.20)	2.744** (13.03)	-8.643** (-6.71)	16.670** (15.69)	14.683** (7.74)
*Ch. No. Bks	0.001** (31.82)	0.001** (4.80)	-0.001 (-0.41)	0.001** (11.92)	0.001** (3.44)
*E/A	0.009 (1.42)	2.158** (32.69)	-0.829** (-23.56)	0.041 (0.72)	-0.010 (-0.86)
*Size	0.236** (19.99)	-0.054** (-4.54)	0.042* (2.02)	0.516** (18.71)	0.403** (5.75)
*Growth	-0.646** (-47.65)	-0.026 (-1.40)	-1.609** (-46.42)	-0.799** (-29.75)	-0.418** (-6.18)
*L/A	-0.340** (-7.65)	0.271** (7.41)	0.105 (1.90)	0.127 (1.10)	-0.394* (-2.06)
R-squared	0.64	0.61	0.69	0.79	0.95
Q1	0.14	0.34	0.21	0.16	0.34
Notes: Entries are coefficient values (<i>t</i> -statistics in parentheses) for equation (5.7), where bank profits are regressed on lagged bank profits and the interaction terms given by: Mkt Share is market share by total assets, HHI is the Herfindahl-Hirschmann Index, GDP is gross domestic product, E/A is the equity-to-assets ratio, Size is given by total assets, growth is the change in total assets, L/A is the loans-to-assets ratio, Ch represents the change and L the natural logarithm. These terms are also entered in the regression individually but are not reported. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test. * (**) denote 5% (1%) statistical significance.					

Table 5.5. Time-Varying Persistence – Below Median Banks (Quantile 2)					
	All	1976-1983	1984-1991	1992-2000	2001-2009
Profit(-1)	0.223* (2.04)	0.198** (5.83)	0.239** (9.50)	0.216** (8.47)	-0.495 (-1.33)
*Mkt Share	20.776 (0.82)	8.112 (1.43)	28.78** (4.60)	-17.505** (-2.50)	12.336 (0.48)
*Ch. Mkt. Sh	-17.173 (-0.38)	-7.913 (-0.32)	-53.78** (-19.37)	-7.381 (-0.58)	-9.462 (-0.40)
*HHI	-0.266 (-1.29)	-0.159 (-0.91)	-0.568** (-4.68)	-1.934** (-18.54)	1.031** (2.53)
*Ch. HHI	-0.685** (-2.37)	-0.819 (-0.98)	1.303** (2.88)	4.049** (24.10)	-0.228 (-0.47)
*Ch. GDP	-8.188** (-5.99)	1.801** (5.56)	4.303** (12.99)	-3.989** (-4.89)	-4.178 (-1.61)
*Ch. LGDP	-0.430 (-0.29)	1.489** (5.16)	3.391** (6.49)	-4.305** (-11.73)	5.235** (3.15)
*Ch. No. Bks	0.001** (8.22)	0.001** (5.88)	-0.001 (-1.23)	0.001** (10.56)	0.001 (1.88)
E/A	0.013 (1.98)	-0.292 (-1.35)	0.169 (1.41)	-0.446** (-13.96)	-0.001 (-0.16)
*Size	-0.089 (-0.85)	-0.209** (-6.45)	-0.262** (-11.11)	-0.161** (-6.86)	0.554 (1.54)
*Growth	-0.449** (-9.29)	-0.243** (-6.23)	0.244** (11.49)	-0.042** (-3.73)	-0.376** (-3.88)
*L/A	-0.750** (-8.03)	0.183** (3.14)	0.058 (1.46)	0.485** (21.93)	-1.359** (-4.78)
R-squared	0.48	0.69	0.68	0.89	0.92
Q1	0.08	0.11	0.61	0.16	0.24
Notes: Entries are coefficient values (<i>t</i> -statistics in parentheses) for equation (5.7), where bank profits are regressed on lagged bank profits and the interaction terms given by: Mkt Share is market share by total assets, HHI is the Herfindahl-Hirschmann Index, GDP is gross domestic product, E/A is the equity-to-assets ratio, Size is given by total assets, growth is the change in total assets, L/A is the loans-to-assets ratio, Ch represents the change and L the natural logarithm. These terms are also entered in the regression individually but are not reported. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test. * (**) denote 5% (1%) statistical significance.					

Table 5.6 presents the results of equation (5.7) for the medium-large category of banks (quartile 3). As before, the results are a mixture of similarities and differences with those reported for all banks and the previous size categories. Over the full sample period, market share has a negative effect, while the change in market share has a positive effect. However, the evidence from the sub-samples appears to show this relationship changes over time with the sign of the coefficients often switching. This is similar to that reported previously although there are differences in the degree of significance. In general though, increases in market share are consistent with increases in persistence, but the overall level suggests a negative relationship. As with the smaller category of medium sized banks, the relationship with size and growth is no longer consistent across both the full and sub-sample periods. For all banks, we saw size as being positive and growth negative; here growth switches between a positive and negative effect, while size is less consistent and insignificant in two sub-periods. The loans-to-assets ratio is positive over the full time sample and in three of the four sub-samples, only being negative in the period 1992-2000. This differs from previous results where there was a switch from positive to negative across the sub-samples. Here the final sub-sample is positive. This suggests that, for this category of bank, a larger loan portfolio leads to higher profit persistence. In contrast to all banks and the smaller medium sized category, the equity-to-assets ratio is insignificant over the full sample. Further, it is negative in two of the sub-samples. Thus, as with the previous two categories, the effect of capital structure is more subdued than reported for all banks. With regard to the market structure variables, although there remains a small positive effect from the change in the number of banks, there is very little in the way of a statistically significant effect from market concentration through the HHI and change in

HHI variables. The main exception is for the time period 1992-2000, where both the level and change in HHI is associated with a positive effect on persistence. Finally, we can see that GDP growth has a positive effect over the first half of the sample, but the effect is largely negative over the second half of the sample. Again, we could read these results in the context of the rolling and recursive plots for this size category, where persistence declined in the 1980s and remained low relative to the other size categories.

Table 5.7 presents the results for large banks (quartile 4). In relation to the bank specific factors, market share has an overall insignificant effect, which is positive and significant over the sub-periods 1976-1983 and 1991-2000, while it is insignificant between 1984-1990 (although the coefficient is positive) and negative between 2001-2009. Thus the overall coefficient value masks noticeable variation. In general, therefore, a higher market share is associated with higher persistence for this category of bank. However, the change in market share is associated with a negative effect on persistence in the periods 1976-1983 and 1991-2000, perhaps as a trade-off for the gain in market share. In contrast to the overall results in Table 5.3, size predominantly has a negative effect with persistence, as to does growth. This is more consistent with the overall results, albeit that there is a positive result over the period 1984-1999 and not significant in the final sub-period. The loans-to-assets ratio and the equity-to-assets ratio are insignificant over the whole period, but this masks periods of a positive effect for the former and a negative effect for the latter in different sub-samples. These associations are consistent with the view that a larger loan portfolio and a smaller equity/debt ratio are consistent with higher profit persistence. Noticeably, both these effects are insignificant in the final sub-sample, where, ex post, greater liquidity and equity capital have proved necessary. With regard to the market structure variables, the

number of banks typically has a positive relationship in the first two sub-samples but is insignificant and negative in the latter two sub-samples. This suggests that as the number of banks has fallen, the incumbents in this size category are able to increase profit persistence and maintain their position. This is supported, to a certain extent, by higher market concentration also increasing persistence. Thus, large banks in a concentrated part of the market are able to maintain profit performance. Finally, GDP growth typically has a positive effect on persistence; furthermore, the current level of GDP growth is more important than lagged values as occurred, for example, with small banks.

Overall, the results presented in this chapter have demonstrated that profit persistence in US commercial banks is time-varying and that this time-variation is linked to bank specific and market structure factors as well as economic conditions. Moreover, the results show that not only is there time-variation in profit persistence but that there is also time-variation in the factors that cause time-varying persistence. Furthermore, this variation in the factors occurs across both time and size categories of banks. Given this, it is difficult to generalise when commenting upon the effects of the bank specific, market structure and economic factors on persistence.

Table 5.6. Time-Varying Persistence – Above Median Banks (Quantile 3)					
	All	1976-1983	1984-1991	1992-2000	2001-2009
Profit(-1)	0.876** (7.14)	-0.876** (-4.37)	-0.195 (-0.73)	0.977** (37.70)	-0.473 (-1.33)
Mkt Share	-5.406 (-2.20)	0.619 (0.21)	-5.403** (-2.40)	52.719** (14.89)	-16.613 (-1.88)
Ch. Mkt. Sh	5.403 (1.96)	75.73** (4.89)	-22.821 (-1.80)	-102.879** (-25.08)	29.731* (2.15)
*HHI	-0.232** (-2.97)	0.309 (1.44)	-0.084 (-0.64)	0.987** (11.27)	-0.182 (-0.75)
*Ch. HHI	0.588** (5.09)	0.608 (0.57)	-0.169 (-0.30)	0.524** (2.96)	0.157 (0.59)
Ch. GDP	-0.936 (-2.28)	3.127** (7.36)	2.791** (7.55)	-7.141** (-7.44)	-16.105** (-7.30)
*Ch. LGDP	2.237** (5.60)	2.526** (6.29)	3.900** (6.16)	-3.378** (-8.21)	2.805 (1.20)
*Ch. No. Bks	0.001** (3.15)	0.003** (9.15)	0.001** (2.98)	0.003** (5.59)	0.002** (2.35)
*E/A	0.001 (0.23)	-1.789** (-11.53)	-0.003 (-0.01)	-0.138* (-2.28)	-0.001 (-0.28)
*Size	-0.180** (-7.54)	0.153** (3.34)	-0.001 (-0.04)	-0.808** (-36.24)	0.121 (1.22)
*Growth	-0.026** (-2.44)	-0.635** (-10.29)	0.036** (2.93)	-0.426** (-29.44)	0.245** (4.69)
*L/A	0.666** (26.95)	0.639** (8.16)	0.233** (8.23)	-0.259** (-7.37)	0.867** (9.18)
R-squared	0.96	0.70	0.66	0.73	0.98
Q1	0.14	0.24	0.38	0.08	0.73
Notes: Entries are coefficient values (<i>t</i> -statistics in parentheses) for equation (5.7), where bank profits are regressed on lagged bank profits and the interaction terms given by: Mkt Share is market share by total assets, HHI is the Herfindahl-Hirschmann Index, GDP is gross domestic product, E/A is the equity-to-assets ratio, Size is given by total assets, growth is the change in total assets, L/A is the loans-to-assets ratio, Ch represents the change and L the natural logarithm. These terms are also entered in the regression individually but are not reported. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test. * (**) denote 5% (1%) statistical significance.					

Table 5.7. Time-Varying Persistence – Large Banks (Quantile 4)					
	All	1976-1983	1984-1991	1992-2000	2001-2009
Profit(-1)	0.105 (1.04)	0.619** (2.77)	0.440** (3.34)	0.614** (5.03)	0.346 (1.36)
*Mkt Share	-0.317 (-1.26)	2.134** (4.05)	0.087 (0.30)	1.267** (5.89)	-1.712* (-2.17)
*Ch. Mkt. Sh	-1.639** (-4.15)	-5.236* (-2.22)	1.414 (1.58)	-1.051** (-2.39)	-1.247 (-1.44)
*HHI	0.455** (8.62)	0.763** (2.92)	0.038 (0.21)	-0.406** (-3.74)	0.805** (7.43)
*Ch. HHI	0.017 (0.33)	-4.025** (-3.35)	0.611 (0.98)	1.417** (9.28)	-0.267* (-2.26)
*Ch. GDP	2.106** (4.72)	1.853** (3.31)	1.285** (2.53)	3.174** (3.13)	7.979** (5.63)
Ch. LGDP	-0.413 (-0.79)	0.002 (0.03)	-1.993 (-2.14)	-3.745** (-8.96)	1.471 (0.73)
*Ch. No. Bks	-0.001** (-2.51)	0.003** (7.40)	0.002** (5.36)	0.001 (0.06)	-0.001** (-2.34)
*E/A	-0.009 (-0.60)	-2.070** (-4.84)	-1.360** (-20.14)	0.035 (0.59)	-0.017 (-0.65)
Size	0.010 (1.21)	-0.030 (-1.94)	-0.020 (-2.05)	-0.045** (-5.60)	-0.037 (-1.82)
*Growth	-0.105** (-13.55)	-0.420** (-8.19)	0.030** (2.52)	-0.036** (-3.88)	-0.059 (-1.80)
*L/A	-0.024 (-0.94)	0.144 (1.38)	0.512** (10.26)	0.219** (8.17)	-0.124 (-1.85)
R-squared	0.083	0.70	0.59	0.57	0.94
Q1	0.05	0.09	0.59	0.06	0.12
Notes: Entries are coefficient values (<i>t</i> -statistics in parentheses) for equation (5.7), where bank profits are regressed on lagged bank profits and the interaction terms given by: Mkt Share is market share by total assets, HHI is the Herfindahl-Hirschmann Index, GDP is gross domestic product, E/A is the equity-to-assets ratio, Size is given by total assets, growth is the change in total assets, L/A is the loans-to-assets ratio, Ch represents the change and L the natural logarithm. These terms are also entered in the regression individually but are not reported. Q1 is the <i>p</i> -value for a first-order residual autocorrelation test. * (**) denote 5% (1%) statistical significance.					

However, we can nonetheless make the following salient points. First, as stated above, profit persistence is time-varying and linked to explicitly identifiable factors. Second, GDP growth typically has a positive effect on profit persistence, although this may be lagged, especially for small banks. This supports the view of greater stability within banking during economic expansions. Third, bank size generally has a positive effect, although this breaks down with bigger banks, while growth has a negative effect. This is consistent with the view of greater stability within large banks, which are able to diversify, while bank growth inevitably involves additional costs that affect profit. Fourth, the equity-to-assets ratio is typically positive for smaller banks but becomes negative or insignificant for larger banks. Fifth, the size of the loan portfolio is also typically negative especially in the later part of the sample and for smaller banks. For larger banks and the earlier part of the sample, the relationship is often positive. As noted, these results suggest the increased need to liquidity and an equity buffer in the later part of the sample. Finally, the effect of market share and concentration differ quite substantially over the sample period and with bank size, although the change in the number of banks typically has a positive effect on persistence. Notwithstanding this, and in terms of the policy debate, there is no clear evidence that greater concentration leads to higher persistence (and lower competitive pressure).

5.5. Summary and Conclusion.

The aim of this chapter was to examine the presence and source of time-variation within the profit persistence parameter. In particular, it is important, from a policy perspective, to know whether time-variation exists within persistence and what factors determine

any such variation. That is, policy-makers need to know how different factor may interact with persistence before enacting regulatory changes, given the belief that the degree of profit persistence is a proxy for the strength of competition within the industry.

In order to determine whether profit persistence exhibits time-variation, we first considered rolling fixed window and recursive expanding window regressions for the persistence parameter. Evidence from these two approaches revealed substantial time-variation, with persistence declining in the late 1980s and rising in the late 1990s/early 2000. Persistence also falls during the financial crisis period. In examining the rolling and recursive persistence parameter according to the size of banks, we see that both small and large banks follow this same general pattern. However, medium sized banks have seen persistence decline during the 1980s and generally stay low and even decline further for the remainder of the time period. Nonetheless, the rolling and recursive plots provide evidence of time-variation.

To further examine whether time-variation exists in profit persistence. The chapter also considers some simple non-linear threshold regressions. These are designed to determine whether the persistence parameter changes over time, between different regimes of behaviour according to some specific threshold variable. In particular, we considered four different threshold variables: lagged profit, lagged GDP growth, lagged fitted profit from a regression and lagged ratio of non-interest income to total income. As with the rolling and recursive plots, these regressions were run for all banks and also separated by bank size. The regression results from these threshold models are largely supportive of time-variation as the persistence parameter does indeed vary over different regimes of behaviour. In particular, for all banks we see that persistence is

higher when GDP growth is positive, that is, when the economy is expanding, when fitted profits are positive (above normal) and when the degree of bank diversification is above average. This suggests that competitive forces impact less on banks when GDP is growing, as banks are more diversified and when banks are more profitable. This general pattern appears also to hold for most size categories of banks, with the key exception of large banks. Here, it is noticeable that persistence is higher with a lower degree of non-interest income to total income. This may suggest that such large banks have a tendency to over diversify and this contributes to the volatility of profits. Nonetheless, the main aim of this exercise was to consider whether time-variation could be supported in the persistence of profits parameter and the results suggest that it can be.

Given the presence of time-variation within persistence, we then consider what factors may affect such time-variation. We consider the possibility of bank specific, market structure and economic environment factors. Should these contribute to persistence, and hence the underlying competitive pressures, then this would have implications for policy. Again, we consider these effects for all banks and also separated by bank size. Furthermore, we also separate the sample in to four roughly equal sub-periods to examine whether the influence of these factors has themselves changed over time. The regression results suggest two key results. First, that time-variation is related to all three of bank specific factors, market structure factors and economic factors. Second, that there is noticeable time-variation within the effect of these different factors on persistence. Further, that both of these hold in the regression for all banks as well as the regression organised by bank size. Given the substantial variation in results over time, it is difficult to generalise the effects or to summarise them succinctly. However,

generally, GDP growth has a positive effect on persistence. This means that profit persistence is higher when the economy is expanding. This would seem intuitive as an expanding economy would present more profit opportunities for banks. With regard to the market structure, the number of banks tends to have a positive relationship with persistence, although this does vary to a certain degree with bank size and time, it does suggest that more banks does not necessarily mean more competition. Although one exception to this is the large bank category, hence, more large banks could lead to greater competition. The variable relating to market concentration (HHI) is typically negative. As such, this suggests that a higher degree of market concentration and less banks leads to a lower degree of profit persistence. Where less banks and greater concentration may suggest a lower degree of market competition, the results here suggest that less competition may lead to more risk-taking and hence more volatile profits or it may lead to complacency and lower efficiency. Hence, profit persistence becomes lower. However, there are variations to this result, for example, over the period 1984-1991, where market concentration had a positive relationship. This is also a period where deregulation began and thus, this result may arise as more efficient banks begin to capture market share of less efficient banks. Hence, the market becomes more concentrated while persistence for incumbent banks increases. With regard to bank specific factors, bank size generally has a positive effect, although this breaks down with bigger banks, while growth has a negative effect. The equity-to-assets ratio is typically positive for smaller banks but becomes negative or insignificant for larger banks. This suggests that the capital structure and equity buffers effects differ with bank size. The size of the loan portfolio is also typically negative especially in the later part of the sample and for smaller banks. For larger banks and the earlier part of the sample,

the relationship is often positive. These results perhaps suggest that profit persistence was associated with banks that had a large loan portfolio early in the sample, but emphasise the increased need for liquidity and a larger equity buffer in the later part of the sample.

Overall, and from a policy perspective, these results suggest that, where profit persistence is a proxy for the outcome of market competition, the relationship between competition and bank and market factors is complex. First, the results highlight the importance of economic growth on persistence (and hence the competitive nature of the market). Second, that there is no simple relationship between, for example, bank size, market concentration or the amount of equity capital and persistence. Thus, policy must be conducted in the context of such variation.

6. Competition and Risk in US Banking

6.1. Introduction.

Competition in the banking sector has far-reaching implications for the stability of this industry. Banks function as intermediaries between firms and borrowers and operate maturity-transformation in their asset-liability management, thus banks play an important role as providers of liquidity to depositors. However, this also exposes banks to runs and systemic crises. Furthermore, there exists a severe agency problem between banks and depositors. This occurs as a result of the fact that a large proportion of funds are made up of deposits, however as banks are subject to limited liability, they do not bear the downside of risk but rather may have strong incentives to choose risks that are excessive from the viewpoint of depositors.

The issue of how competition affects the stability of the banking system, as well as the effectiveness of regulation, has yet to reach a consensus in the research literature. Indeed, the desirability of competition in the banking sector has been questioned for a long time. In response to the crises of the 1930s, competition was limited in order to promote stability within the banking sector. As deregulation was implemented throughout the 1980s and 1990s, restrictions on competition were lifted, resulting in more opportunities for banks to expand their investments into, arguably, riskier activities and new locations. This increase in competition was widely regarded as the main reason for the ensuing instability that occurred during the 1980s and 1990s, following a wave of bank failures. For instance, Keeley (1990), found that the decline of banks' margins and charter values further exasperated the agency problem between

banks and depositors (or deposit insurance fund), thereby encouraging banks to engage in excessive risk taking, leading to a much greater probability of bank failure.

Earlier research throughout the 1990s, into the relationship between competition and risk has, on balance, uncovered a negative correlation between the two. However, more recently research has shown the relationship to be much more complex than previously assumed. For instance, a number of studies outlined in the literature review section, have sought to examine what the trade-offs between competition and risk are; how the competitive environment impacts upon banks' incentives to take risks as well as their vulnerability to runs; and finally the impact of competition on regulatory policy designed to promote stability. This has led to the development of two opposing hypotheses, the competition-stability hypothesis and the competition-fragility hypotheses. As the names of these hypotheses suggest, the former posits that an increase in competition leads to a more stable banking system as competition reduces interest rates on loan and the likelihood of default; while the latter hypothesis states that increased competition reduces a banks' ability to withstand negative shocks as capital buffers are reduced.

In related but distinct work, Köhler (2014) focuses purely on the role of diversification (non-interest income) in overall bank risk. Examining data from the German banking system, Köhler argues that an increase in diversification reduces risk for a retail-focussed bank but increases it for an investment-focused bank. Instead, investment-focussed banks could diversify into interest income activities as further increases in non-interest income may cause over-diversification. In contrast, retail-focussed banks, which generate most of their income from interest income activities, would benefit from the diversification effect of non-interest income activities. The

purpose of this chapter is to focus on the relationship between several types of risk and market structure for all commercial banks as a whole. That is, this chapter seeks to begin with an overall perspective on the issues relating to risk and competition before any consideration of finer disaggregation of banks. Nonetheless, a further examination of the risk for different bank types is worthy of future investigation.

This chapter seeks to add to the literature examining the relationship between bank competition and bank risk by building on the work of Berger et al. (2009) which examined the cross-sectional relationship between market structure and bank risk for a range of countries. In particular, these authors averaged their data across all banks in their sample period to implement cross-sectional analysis. The aim of this chapter is to build on this basic framework but to examine the relationship between market structure and bank risk in a panel structure for US banks. That is, we examine a panel dataset for the period 1984 to 2009, thereby including all banks, survivors and non-survivors, throughout the time period. In particular, we consider three measures of risk, relating to loan risk, total risk and the equity buffer and examine the relationship with market structure while controlling for bank-specific characteristics. In addition to examining this relationship for all banks, we further consider whether the risk characteristic differs between banks of different size.

Furthermore, in the model employed in this chapter, we seek to examine the impact of a key regulatory change on bank risk. In particular, a dummy for the 1999 Financial Modernisation Act is included in our analysis; hence, one focus of the modelling here is to examine the impact of this 1999 regulatory change on banks' risk.¹³

¹³ A dummy was also included for the 1994 Riegle-Neal Act; however, the results revealed little of any significance and are thus not discussed again.

This is of interest, given the global events relating to banking that have occurred since the 2007 financial crisis began. The analysis of this chapter therefore seeks to gain an insight into an issue that has re-emerged as an important policy debate within the banking literature. That is, whether or not the effective repeal of the Glass-Steagall Act implemented in 1933, increased risk within the banking sector. Recent debate has surrounded the issue to once again separate commercial and investment banking, and the possible introduction of narrow banking. A term which refers to a system in which the activities banks can engage in are narrowly defined. That is, such banks can obtain deposits from the public which are backed by liquid and safe assets, typically government bonds. These banks are prohibited from investing in equities, derivatives and complex structured products. Such activities can only be performed by investment banks and other financial institutions which cannot fund these investments from the deposits of either the public or commercial banks. For further discussion see Ghosh and Sagar (1998), Wallace (1996) and De Grauwe (2009).

In preview of the results, we find that there is a difference in the nature of the relationships between loan risk and other measures of risk. Notably, the results for loan risk appear to support competition-stability hypothesis, with higher competition leading to a lower level of non-performing loans. Whereas, increases in competition appear to lead to lower z-score values (greater risk) and lower equity-to-asset ratios, which support the competition-fragility view. This appears to suggest that banks view the risks associated with different aspects of bank behaviour differently. Furthermore, there also appears to be a distinction between small and medium sized banks on the one hand and large banks on the other. That is, the relationship between risk and market structure is similar for small and medium sized banks (albeit with some differences in the

magnitude of the response). However, for large banks, there appears to be no relationship with market structure, suggesting that competitive pressure per se do not affect risk. The risk behaviour of such banks is predominately affected by the state of the economic cycle, while it is also noticeable that they are characterised by riskier behaviour overall, with a lower z-score and equity-to-asset ratio than other sized banks. Finally, a further examination of bank risk behaviour according to whether the bank exhibited above or below profits or whether the bank exhibited positive or negative growth reveals less differences between banks. However, across all categories of banks, GDP growth is an important factor.

The remainder of this chapter proceeds as such. Section 6.2 presents a summary of the key literature, Section 6.3 introduces the empirical methodology, Section 6.4 presents the empirical results and Section 6.5 summarises and concludes.

6.2. Literature.

Most of the literature on the relationship between competition and risk seeks to analyse the impact that competition has on banks' incentives to undertake risk. There are two broad approaches, namely theoretical studies versus empirical studies. The theoretical literature is presented in two sections. Namely, competition-stability hypothesis for which the model predicts a negative relationship between the variables and competition-fragility hypothesis whereby the model predicts a positive relationship between the variables. The empirical literature is also presented in two sections according to whether the studies are at the bank-level with a focus on one country, or whether they examine cross-country data. With regard to the relationship between competition and

risk, bank-level studies produce ambiguous results, whereas cross-country studies mostly uncover a positive relationship between the variables. A review of the literature examining the relationship between competition and bank risk is presented in section 3.7.

6.3. Empirical Methodology.

The empirical analysis in this chapter broadly follows the methodology introduced by Berger et al. (2009). This model relates bank risk primarily to market structure, which is introduced in a non-linear fashion following Martinez-Miera and Repullo (2010), but also includes measures relating to bank-level and economy-level factors. Following Berger et al. (2009), the model takes the following general form:¹⁴

$$\text{Bank Risk}_i = \alpha_0 + \alpha_1 \text{Market Structure}_i + \alpha_2 \text{Market Structure}_i^2 + \sum_j \beta_j \text{Bank Controls}_{ij} + \sum_k \gamma_k \text{Business Environment}_k \quad (6.1)$$

That is, bank risk is a non-linear function of market structure and a linear function of bank specific control variables and the general business (or economic) environment. We can use this general model to examine the nature of the relationship between market structure (or competition) and bank risk, hence we can consider the competition-stability and competition-fragility hypotheses. Here, the former would imply that a more competitive market structure would lead to lower bank risk, while the latter would imply that a more competitive market structure would lead to higher bank risk.

We use three different measures of risk as the dependent variable. The three risk measures are complimentary to each other, capturing different aspects of bank

¹⁴ Berger et al (2009) use the term financial stability in equation (6.1), but we prefer to use bank risk as that is the dependent variable being directly estimated.

behaviour. Thus, we hope to identify whether market structure affects different areas of bank risk. The first measure is the ratio of non-performing loans to total loans (NPLs). This proxies for the riskiness of banks' loan portfolios. As such an increase in this ratio would indicate an increase in risk. Evidence of a positive relationship, for example, between this measure and market structure would imply that as the banking industry becomes less competitive and more concentrated (increasing market power), so banks increase the riskiness of their loan portfolio. Such a relationship would support the competition-stability hypothesis, where greater competition would imply less risk. The second risk measure used is the Z-score, which is an inverse measure of overall bank risk. As such, a greater value of the Z-score would imply lower risk. Hence, in this case a positive relationship between market structure and the Z-score would support the competition-fragility hypothesis, where a higher degree of market power leads to greater bank stability. Our final risk measure is the ratio of equity to total assets (E/TA). This effectively measures the extent of the equity capital cushion that a bank may hold, perhaps to guard against any loss from a risky loan portfolio. As such, a positive relationship with market structure would imply that greater market power leads to a high cushion, while greater competition would result in increased risk, again supporting the competition-fragility hypothesis.

As noted above, the Z-score is an inverse proxy for the bank's probability of failure, it combines profitability, leverage and return volatility in a single measure and is given by the following ratio:

$$Z_{i,t} = \frac{ROA_{i,t} + E/TA_{i,t}}{\sigma_{ROA_{i,t}}} \quad (6.2)$$

Where ROA_{it} is the return on assets for bank i at time t (note that while Berger et al, averaged this, and other value(s) over the sample period, we allow for time-variation), E/TA_{it} is the ratio of equity to total assets for bank i at time t and $\sigma_{ROA_{it}}$ is the standard deviation of return of assets over the sample period.¹⁵ A higher Z-index reflects greater stability, which can arise from increased profitability and/or capitalisation levels. Conversely, the Z-index decreases (and hence risk increases) with unstable earnings as indicated by a greater standard deviation of return on assets. The Z-index is calculated at the bank level, thus providing an indicator of financial soundness for individual banks.

In order to proxy for market power we use two approaches. Indeed, as argued by Inklaar et al (2012), measuring market structure is a literature in its own right with no single consensus on the preferred approach.¹⁶ Thus, following Berger et al (2009) and Demircuc-Kunt and Peria (2010) we adopt two procedures; first the HHI measure calculated in the previous chapter and second the Lerner index. The HHI measure follows from the structure-conduct-performance paradigm, which postulates that fewer and larger firms tend towards uncompetitive behaviour. However, it does not necessarily follow high concentration leads to less competition as market contestability is also important. That is, if barriers to entry and exit are low then incumbents may be forced to act competitively. Therefore, we also consider the Lerner Index, which is a non-structural and direct measure of market power whereby the degree of competition is inferred from bank behaviour. The Lerner Index represents the mark-up of price over

¹⁵ Specifically, we use each period's values for ROA and E/TA, while the standard deviation is updated in a recursive fashion and each new time period becomes available.

¹⁶ Indeed, as an example of this, while we consider the HHI and Lerner index measures as also considered by those cited above, Liu et al (2012) in examining risk in South-East Asian commercial banking utilise the Panzar-Rosse (1987) H-statistic.

marginal costs, thus providing an indicator of the degree of market power afforded by banks. As such, therefore, a higher Lerner index indicates a higher degree of market power and lower levels of bank competition. Therefore, we consider the Lerner index below. That specification used here for the Lerner Index broadly follows that in Berger et al (2009), Demirguc-Kunt and Peria (2010) and Liu and Wilson (2013).¹⁷

The Lerner index is calculated as follows:

$$\text{Lerner}_{it} = (P_{TAit} - MC_{TAit}) / P_{TAit} \quad (6.3)$$

Where P_{TAit} is the price of total assets, which is proxied by the ratio of total revenues (interest and noninterest income) to total assets, for bank i at time t ; and MC_{TAit} is the marginal cost of total assets for bank i at time t . The Lerner Index is calculated for each individual bank and is averaged over the sample period. MC_{TAit} is calculated using the following translog cost function:

$$\begin{aligned} \ln \text{Cost}_{it} = & \beta_0 + \beta_1 \ln Q_{it} + \frac{\beta_2}{2} \ln^2 Q_{it} + \beta_3 \ln W_1 + \beta_4 \ln W_2 + \beta_5 \ln W_3 + \beta_6 \ln Q_{it} \ln W_1 + \beta_7 \\ & \ln Q_{it} \ln W_2 + \beta_8 \ln Q_{it} \ln W_3 + \beta_9 \ln W_1 \ln W_2 + \beta_{10} \ln W_1 \ln W_3 + \beta_{11} \ln W_2 \ln W_3 + \beta_{12} \text{Trend} \\ & + \beta_{13} \text{Trend}^2 + \beta_{14} \ln Q_{it} \text{Trend} + \beta_{15} \ln W_1 \text{Trend} + \beta_{16} \ln W_2 \text{Trend} + \beta_{17} \ln W_3 \text{Trend} + \varepsilon_{it} \end{aligned} \quad (6.4)$$

where Q_{it} is a proxy for bank output (total assets) for bank i at time t (e.g. Shaffer, 1993; Berg and Kim, 1994; Fernandez de Guevara, Maudos and Pérez, 2007). $W_{k,it}$ represents three input prices. Specifically, $W_{1,it}$ corresponds to the input price of labour, calculated as the ratio of personnel expenses to total assets. $W_{2,it}$ indicates the input

¹⁷ As an aside, various papers including those cited above as well as Koetter et al (2012), all have slightly different specifications, with no agreed consensus.

price of funds, calculated as the ratio of interest expense to total deposits. Finally, $W_{3,it}$ denotes the input price of fixed capital and is calculated as the ratio of other operating and administrative expenses to total assets. The trend terms are included to capture technical changes in the cost function over time. In practical application of the above equation it has been suggested (e.g., Turk-Ariss, 2010) to scale costs and the input measures by W_3 , we find this makes little difference to the final outcome. The cost function is estimated for each firm to allow for differences in their respective technologies and marginal cost is then computed as:

$$MC_{it} = \frac{Cost}{Q} [\beta_1 + \beta_2 \ln Q + \beta_6 \ln W_1 + \beta_7 \ln W_2 + \beta_8 \ln W_3 + \beta_{14} \text{Trend}] \quad (6.5)$$

The Lerner Index included in the regression of equation (6.1), is calculated for each individual bank. While the Lerner Index does not capture risk premia in the prices of banks' product and services (association with monopoly rents), it is however, the only measure of competition that is computed at the bank level.

In addition to the market structure variable, we also include further variables to capture both bank specific effects and the market environment. To this end, therefore, we include in the regression measures for bank size and bank growth, the ratio of loans to assets (to capture liquidity) and the ratio of non-interest income to total income (to capture the effects of diversification). Finally, we also include annual GDP growth to measure the position (in the business cycle) of the external market environment. Subsequent to this, we also re-run the regression to include dummy variables for both the 1999 Financial Modernisation Act and the liquidity crisis (credit crunch) that began in 2007. Here, we wish to consider whether the change in regulation as well as the severity of the crisis affected risk.

As in the previous chapter a consideration prior to estimation is that of endogeneity in the regression. In contrast to the previous chapter there is no lagged dependent variable in this regression and thus that eliminates one potential source of complication. That is, in a fixed effects regression where the fixed effects partly determine the dependent variables then they will be correlated with the lagged dependent variable.

However, two potential sources of endogeneity remain. First, there is the potential for correlation between the explanatory variables. We control for this, following Liu and Wilson (2013) by including the explanatory variables in lag form. Second, there exists the potential for the direction of causality between the market power terms and the dependent variables to be reversed. As noted by Berger et al (2009), while our regression suggest that market power has explanatory power for bank risk, there exists the potential for reverse causality. For example, a growing bank that expands its loan portfolio and the risk associated with that may also seek to gain a higher degree of market power. Similarly, a bank that is growing and perhaps increasing its level of debt may also capture a higher degree of market power. The use of lags outlined above will help control for such endogeneity.¹⁸

¹⁸ A GMM approach was also considered with results qualitatively similar to those reported.

6. 4. Data and Empirical Results.

6.4.1. Data.

The dataset used in this chapter is the same as used previously and thus much of the data has already been presented. That is, the data is collected from the Call reports for individual banks over the full time period of 1976 to 2009, although specific data availability means the sample size in estimation is often shorter (starting 1984). Further, we include all bank data available (including new banks and those that died during the sample period), giving a total number of cross-sections at 23,129. As in the previous chapter, small banks are excluded as are banks with equity to total asset ratios of less than 1%. Again, non-continental US banks are also excluded (except Alaska). Some simple summary statistics for the three risk measures are presented in Table 1, while Figure 1 presents an average across all banks of the Lerner Index.

Table 6.1. Summary Statistics for Measures			
	Non-Performing Loans/Total Loans	Z-Score	Equity/Assets
Mean	0.0098	0.4152	0.1492
Median	0.0015	0.2585	0.0879
Standard Deviation	0.3807	0.2940	0.3476
Notes: Non-Performing Loans/Total Loans measures loan portfolio risk. Z-Score measures overall bank risk and is calculated as the return on assets plus equity to total assets ratio, divided by the standard deviation of return on assets over the sample period. Equity/Assets ratio is an inverse measure of leverage. See Section 6.3 for discussion and construction of risk measures.			

The pertinent points arising from Table 6.1 are that non-performing loans to total loans and equity to total assets both exhibit a relatively small mean but a larger standard deviation. This suggests a large degree of variation amongst banks in their loan portfolio risk and their equity buffer. The results are very similar to those found in Berger Table 2. Figure 6.1 presents the average Lerner Index across all banks and

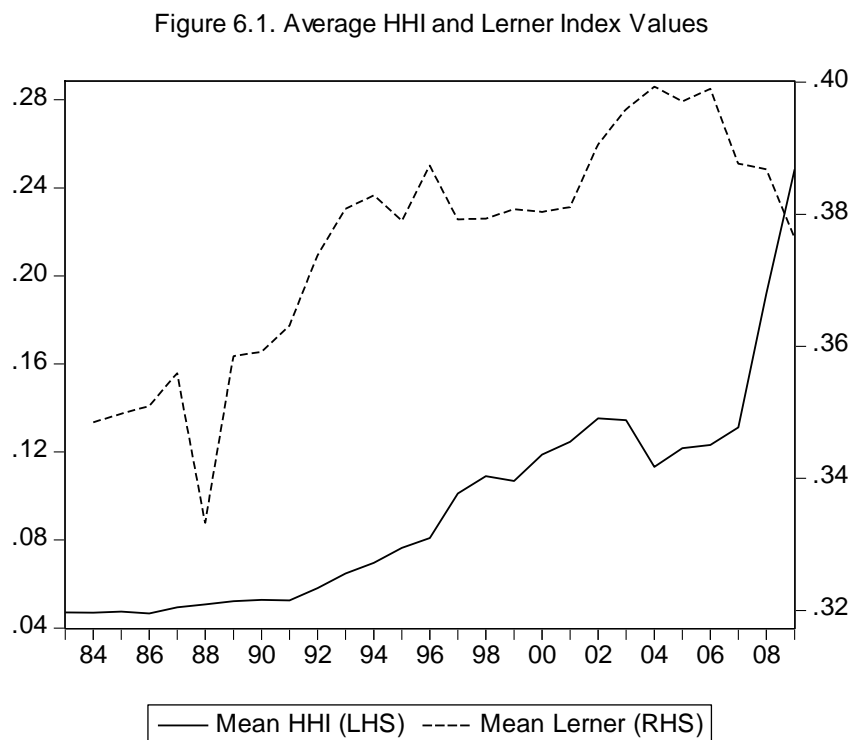


Figure notes: Left Hand Scale presents the series values; Bottom Scale represents time period

includes the average HHI across all banks for comparison. While the Lerner Index is a direct measure of market power or concentration, via the examination of the price mark-up, the HHI is merely a measure of industry structure via the formulation of concentration ratios. What we can see from these graphs is that both measures broadly exhibit the same upward trended pattern suggesting that concentration has increased. However, there are some noticeable differences especially with respect to the financial

crisis period. While concentration has increased, price mark-ups have fallen. With respect to the period surrounding 1999 (GLB Act) there is some evidence of an increase in market power but there is no obvious step change in 1999. This suggests that the effects of the Act took several years to become noticeable in the data.

6.4.2. Empirical Results.

6.4.2.1. Results for All Banks.

Estimation results of the fixed effect panel model for each of the three risk measures and for two different measures of market structure are presented in Tables 6.2 to 6.3. Table 6.2 shows the results of Equation 6.1, excluding the dummies. Prior to discussing the coefficient values, we can see that according to the specification tests, there is residual autocorrelation and heteroscedasticity for most of the models, while explanatory power is relatively modest. These residual tests again support the use of robust *t*-statistics. In terms of the relationship between risk and market structure, the evidence presented in Table 6.2 demonstrates that there is a positive relationship between market structure proxied by the Lerner Index or HHI and non-performing loans as a ratio of total loans. This means that as market power increases (markets become more concentrated) banks undertake more risk in their loan portfolios. That is, as market concentration increases or as individual banks exert greater market power they are willing to increase the risk associated with their loan portfolio. This may arise as such banks feel able to cover any losses from other parts of their activities. Furthermore, this would be consistent with the competition-stability hypothesis.

However, of course loan risk is only one aspect of bank risk, thus we also examine the Z score as a measure of overall bank risk. Here the results in Table 6.2 demonstrate a positive relationship with market structure. Thus, as market concentration or market power increases overall bank risk decreases (shown by a higher Z-score, which indicates a lower degree of risk). Where the Z score includes both profits, equity to assets and the standard deviation of profits, a higher Z score can be achieved by a higher value for the former two and a lower value of the latter. As noted in the previous chapter there exists a positive relationship between profit and concentration and as can be seen below there is also a positive relationship between concentration and power and equity-to-assets. Equally, it is likely that a bank with greater market power may be able to stabilise earnings in a way a bank with less power could not (e.g., through diversification). This therefore, supports the competition-fragility hypothesis in contrast to the previous results. However, as indeed noted by Berger et al (2009) such seemingly contradictory results are not necessarily incompatible as a bank with greater market power will often charge higher loan rates, thus increasing loan risk, while maintaining a lower overall degree of risk.

Finally, with respect to the equity to assets measure of bank risk which captures the extent of a bank's equity buffer used to guard against losses, the results again show a positive relationship. This suggests that as bank market concentration (and individual bank market power) increases, banks accumulate a larger safety net of capital. This is consistent with the previous Z score results, whereby banks with greater market power generally undertake less risk and one route through which they can do that is ensuring a greater capital buffer. Again, therefore, these results support the competition-fragility hypothesis.

Overall, these results point to an interesting context in bank risk. That is, as markets become more concentrated and banks gain greater market power then risk in the loan portfolio increases, suggesting greater competition would lead to less risk in this aspect of bank behaviour and indicative of the competition-stability hypothesis. However, that said, the evidence from the Z-score and the equity-to-assets ratio suggests that as bank market concentration increases, so banks overall appear less risky and thus appeals to the competition-fragility hypothesis. Indeed, the results appear to imply that legislation aimed at increasing stability within the banking industry, need to be tuned for difference aspects of bank activities.

The remainder of Table 6.2 shows the nature of the relationship between our measures of risk and various bank-specific and market variables. The loans to assets ratio, which proxies for liquidity, exhibits a positive relationship with each of our measures of risk. This means that as loans increase it suggests that a higher proportion of these loans will become non-performing. This means that lower liquidity leads to higher loan portfolio risk. With respect to the other two measures of risk as liquidity decreases (loans to assets increases) banks are taking other measures to insulate against this risk. Overall risk decreases and the equity buffer increases. Indeed, part of the explanation for the decrease in overall risk is the increase in the equity-to-debt ratio as means of providing a safety provision against loan loss. The results for non-interest income to total income ratio (which measures diversification), suggests a positive relationship such that diversification typically leads to less risk. Again, this can be explained through the different components of the Z score as greater diversification should lead to a lower standard deviation of profits. However, none of these results are statistically significant thus we cannot be confident in the nature of the relationship.

As banks become bigger and grow quicker (i.e., the bank size and growth measures), there is a negative relationship with all measures of risk. That is, as banks increases in size and growth rate the loan portfolio becomes relatively safer, however other aspects of the bank become more risky. This suggests that bank growth may, in part, be achieved through risk in non-traditional activities. One aspect of the results is that bigger banks have relatively lower equity buffers, suggesting that in times of crisis these banks may be more at risk.¹⁹ The final row shows the relationship between the change in GDP and our measures of risk. These results show that as GDP increases, the loan portfolio becomes relatively safer but the total level of risk increases and the equity to assets buffer decreases. This suggests that during economic boom banks take on more overall risk but have a lower loan portfolio risk, while during recessions the converse is true with bank loans becoming more risky but increased equity buffers mean banks become safer overall.

¹⁹ Indeed, several large banks have been substantially affected during the course of the credit crisis and it has been suggested that such banks did not have adequate capital buffers to deal with the losses incurred in investment activities.

Table 6.2. Empirical Results for Bank Risk and Market Structure						
	Non-Performing Loans/Total Loans		Z-Score		Equity/Assets	
	HHI	Lerner	HHI	Lerner	HHI	Lerner
Mkt Struc.	-0.009 (-0.39)	-0.795** (-5.78)	0.0243 (0.41)	-26.053** (-7.79)	0.094 (0.41)	-9.171** (-7.23)
Mkt Struc ²	0.154 (4.03)	1.219** (5.94)	7.816** (7.68)	44.211** (8.85)	2.960** (7.66)	15.410** (8.13)
Loans/Ass	0.002 (0.29)	0.013 (1.60)	0.505** (2.65)	0.912** (4.54)	0.189** (2.61)	0.328** (4.30)
Non- Int/Tot. Inc	-0.001 (-0.13)	0.001 (1.51)	0.003 (0.24)	0.012 (0.87)	0.001 (0.23)	0.005 (0.86)
Size	-0.033** (-2.42)	-0.006** (-3.83)	-0.105** (-2.87)	-0.181** (-4.52)	-0.042** (-2.99)	-0.062** (-4.08)
Growth	-0.030** (-9.86)	-0.060** (-21.01)	-0.891** (-10.88)	-1.487** (-21.34)	-0.342** (-10.99)	-0.563** (-21.32)
GDP Gr.	-0.266** (-5.93)	-0.446** (-9.08)	-11.225** (-9.43)	-16.835** (-14.09)	-4.281** (-9.47)	-6.360** (-14.04)
R-squared	0.11	0.04	0.09	0.05	0.10	0.05
Q1	0.02	0.01	0.02	0.00	0.54	0.01
Heter.	0.00	0.00	0.01	0.00	0.03	0.01
Notes: Entries are coefficient values for the modelling approach given by equations (6.1) to (6.5) and related text where the dependent variable is a proxy for risk given by the ratio of non-performing loans to total loans, the Z-score or the equity-to-assets ratio. From equation (6.1) market structure is given by either HHI or the Lerner Index. Bank controls are given by Non-Int/Tot. Inc, which is non-interest income to total income and measures diversification, size (total assets) and growth (change in total assets). Business environment is given by the change in GDP. Numbers in parentheses are <i>t</i> -values robust to autocorrelation and heteroscedasticity. * (**) indicates 5% (1%) statistical significance. The estimation sample is 1984 to 2009.						

Table 6.3 presents the same regression models as for Table 6.2 but includes dummy variables both individually and as interactions with the market structure variables. In particular, we include dummies for the 1999 Financial Modernisation Act and the liquidity and ensuing financial crisis period. The results in this table show that there is no statistical effect arising from the 1999 dummy, however, the financial crisis dummy is significant throughout and indicates a stronger response from market structure to the

risk measures.²⁰ More specifically, we see little evidence of the dummy associated with 1999 having any significant effect on the relationship between market structure and bank risk.²¹ Again, as noted in Figure 6.1, there is no evidence of a step-change around this period indicating that the Act has little immediate effect on bank market structure. The effect of the Act may be dispersed over several years. The results from the liquidity crisis dummy do indicate more significance, and support the view that banks have sought to reduce risk following the onset of the crisis. In particular, we can observe an increasingly positive relationship between market structure and both the Z score and equity-to-assets ratio. However, results are not consistent across both measures of market power and it maybe that more data post-crisis is required before a full analysis can take place.

To further examine bank risk and the effect of both market structure and other variables on such behaviour, we again run the regression in equation (6.1) but now consider different sub-samples of banks. In particular, Table 6.4 examines the relationship in equation (6.1) where banks are separated in size categories by quartile. This will allow us to examine whether bank behaviour differs across size. More specifically, we believe that risk behaviour may differ across banks of different sizes because such banks may effectively face different market conditions. That is, for small banks their main risk is more likely to come from lending activities or other aspects of traditional commercial banking. In contrast, larger banks, which are likely to be more

²⁰ When we take these results in context with Figure 6.1, the insignificance of the 1999 dummy may perhaps not be surprising. This is because the Lerner index (although estimated for each bank for the regression analysis and presented as an average in Figure 6.1) shows trending behaviour across the different sub-samples and little evidence of the variability necessary to obtain reliable results. A dummy for regulatory changes in 1994 was also originally included, but was likewise statistically insignificant.

²¹ As with Chapter 4 we also included a dummy for 1994. However, its level of statistical significance was lower than that reported for the 1999 dummy and thus for ease of presentation was excluded from the analysis.

diversified, will face risk not only in commercial operations but also in investment-related activities, and thus, be more exposed to market risk. Equally, operational risk is more likely to be a concern for a larger bank in comparison to a small bank. Examining bank risk over banks of different size is of inherent interest, particular with reference to the behaviour of large banks following the crisis and whether such banks exhibit greater risk.

Table 6.3. Empirical Results for Bank Risk and Market Structure – With Dummies						
	Non-Performing Loans/Total Loans		Z-Score		Equity/Assets	
	HHI	Lerner	HHI	Lerner	HHI	Lerner
Mkt Struc.	-0.0537 (-1.13)	-0.4875 (-3.37)	0.388 (1.89)	-2.973** (-4.08)	0.906 (1.89)	-5.045** (-3.78)
Mkt Struc ²	0.0089 (0.06)	0.6690 (2.99)	-0.739 (-1.28)	7.147** (4.29)	-1.782 (-1.27)	8.104** (3.93)
Mkt Struc.* Dum 1999	0.0719 (1.41)	0.0805 (0.67)	-1.436 (-1.06)	-1.121 (-0.90)	-0.537 (-1.04)	-0.300 (-0.27)
Mkt Struc ² * Dum 1999	0.0563 (0.39)	-0.1914 (-0.62)	4.252 (1.12)	3.249 (0.95)	1.584 (1.10)	0.908 (0.32)
Mkt Struc.* Dum 2007	0.1998 (6.18)	-0.3978 (-2.83)	4.486** (6.06)	-10.265** (-2.99)	1.540** (3.13)	-3.309** (-2.55)
Mkt Struc ² * Dum 2007	0.1287 (1.54)	1.2718 (3.58)	6.094** (3.47)	35.609** (4.12)	3.866** (4.60)	12.006** (3.66)
Loans/Ass	-0.0020 (-0.27)	0.0036 (0.43)	0.294 (1.52)	0.608** (2.97)	0.109 (1.48)	0.212** (2.72)
Non- Int/Tot. Inc	-0.0002 (-0.33)	-0.0002 (-0.40)	-0.001 (-0.04)	0.003 (0.24)	-0.001 (-0.05)	0.001 (0.24)
Size	-0.0046 (-2.90)	-0.0092 (-4.70)	-0.176** (-4.17)	-0.283** (-6.10)	-0.069** (-4.27)	-0.103** (-5.83)
Growth	-0.0278 (-8.95)	-0.0635 (-16.68)	-0.788** (-9.54)	-1.403** (17.70)	-0.302** (-9.64)	-0.527** (-17.53)
GDP Gr.	-0.1010 (-2.13)	-0.2072 (-3.88)	-5.587** (-4.44)	-5.633** (-4.24)	-2.141** (-4.48)	-2.200** (-4.37)
R-squared	0.11	0.04	0.09	0.06	0.10	0.05
Q1	0.02	0.14	0.01	0.01	0.44	0.01
Heter.	0.04	0.38	0.01	0.02	0.02	0.02
Notes: Entries are coefficient values for the modelling approach given by equations						

(6.1) to (6.5) and related text where the dependent variable is a proxy for risk given by the ratio of non-performing loans to total loans, the Z-score or the equity-to-assets ratio. From equation (6.1) market structure is given by either HHI or the Lerner Index. Bank controls are given by Non-Int/Tot. Inc, which is non-interest income to total income and measures diversification, size (total assets) and growth (change in total assets). Business environment is given by the change in GDP. Numbers in parentheses are *t*-values robust to autocorrelation and heteroscedasticity. * (**) indicates 5% (1%) statistical significance. The estimation sample is 1984 to 2009.

6.4.2.2. Results by Bank Size.

Table 6.4 presents the results of the estimation of equation 6.1 for each of the three measures of risk, when banks are sub-divided into four categories (quartiles) according to their size (measured by total assets). In examining these results we can draw comparison with the results presented in Table 6.2 for the whole sample of data. In particular, we might expect a difference to emerge between small banks, who may be more concerned with loan risk and large banks, who may be more concerned with operational and market risk. In terms of the specification tests we can see that the use of robust *t*-statistics is required with several models reporting residual autocorrelation and heteroscedasticity. With regard to the explanatory power of the model, we can see that the largest R-squared values occur with the largest banks.

With regard to the non-performing loans as a ratio of total loans measure of risk, we can see in the average value row that while small banks have a slightly riskier loan portfolio than other categories of bank, the difference is small. More noticeable is that the largest banks have a lower loan portfolio risk. In terms of the relationship with market structure, the results for the two middle categories of banks are similar to those for the whole sample. For small banks, while the nature of the relationship remains the

same, i.e., a positive one, such that increased concentration leads to greater risk, the magnitude of the two coefficients are noticeably larger. Indeed, the coefficients exhibit a declining value as bank size increases. As noted above, this may be due to smaller banks being more exposed to credit risk, while larger banks are typically more diversified. Indeed, for the largest category of banks, there is no significant relationship between loan portfolio risk and market structure. In terms of the other variables, small banks behaviour is affected by the ratio of non-interest income to total income, which is a measure of diversification. This suggests that as small banks attempt to diversify they take greater risk in the loan market. Size and growth are also important for small bank, with size exhibiting a positive relationship with risk, but growth a negative relationship, perhaps as banks seek to grow other parts of their business. Across, all bank size categories, GDP growth is important, whereby as growth increase, so loan portfolios decrease in riskiness. Taken across the four bank sizes, these results suggest that small banks have a stronger interaction between market structure and risk, while middle size banks exhibit the same behaviour as reported for Table 2. Large banks, which may be more diversified, have no statistical relationship between market structure and loan risk. Thus, the results for these latter banks are consistent with the competition-stability hypothesis in loan risk. Again, of particular interest, large banks appear to be unaffected by market structure.

With regard to the Z-score measure of bank risk, we can see that the average Z-score value is similar for the small and medium sized banks, but is noticeably lower for large banks, suggesting that while they have slightly lower loan risk, they exhibit greater risk overall. With regard to the results of equation (6.1) by bank size, we can see that small and medium banks have a similar response to market structure, in that there is

a positive relationship, although coefficient magnitudes differ to some degree. This supports the view that increased concentration leads to less risk and the competition-fragility hypothesis. In contrast, although the sign of coefficients for big banks remains the same, the coefficients are not statistically significant. This again suggests that market structure for the biggest banks does not affect risk behaviour. Elsewhere, size, growth and GDP growth also have significant effects on risk, with the same sign as reported in Table 2. Of particular note, therefore, is that Z-scores decline (risk increases) during economic expansions. Overall, these results again suggest that big banks act differently to other banks, while small banks, who differed in their loan risk behaviour, now exhibit similar behaviour to medium sized banks.

The final set of results in Table 4 refers to the regression results for equity-to-assets by bank size. Again, looking at the average values for the equity-to-assets ratio by quartile bank size, we can see that while small and medium sized banks have similar value, the corresponding number for large banks is noticeably smaller. This indicates that large banks hold a smaller (relative) equity buffer and thus are associated with more risk. With respect to the regression results, small and medium sized banks have the same coefficient signs as reported in Table 2 for all banks, indicating support for the competition-fragility hypothesis, where increased competition would lead to greater risk. As before, large banks appear to have no relation with market structure variables. With regard to the remaining variables, again bank size, growth and, especially, GDP growth are important, where there is evidence of increased risk (lower equity buffers) during economic expansions and bank growth.

Overall, these results provide confirmatory evidence across the different risk measures, whereby large banks appear to exhibit different characteristics from other

sized banks. In particular, while they have slightly safer loan portfolios, they are, overall, more risky in the sense of lower Z-scores and equity-to-asset ratios, indicating greater risk in non-traditional banking activities. Furthermore, large banks appear unaffected (not statistically significant) by market structure and their behaviour is predominantly affected by the business cycle. Small banks also indicate some differences, in particular, related to the magnitude of the coefficients, thus indicating a stronger reaction between market structure and risk. This is most noticeable for loan risk, which is perhaps the most prominent risk factor for small banks. The results for medium firms are similar to those presented in Table 2 for all banks. Finally, it is noticeable that for all categories of bank size, bank growth and GDP growth are important. This suggests that phases of the business cycle are a key determinant of bank risk; as are phases of the bank (firm) cycle as they attempt to grow and consolidate. In sum, these results appear to support the view that big banks operate differently to small and medium sized banks, and exhibit riskier behaviour overall. In terms of the competition-fragility and competition-stability hypotheses, these results suggest that different sized banks respond to competition pressures differently in different parts of their business. As such, no single hypothesis dominates. However, taking overall bank risk (Z-Score), the competition-fragility hypothesis dominates, as it does with the equity-to-assets measure; but loan risks suggest the opposite, especially for small banks. Again, large banks appear to operate with less concern for market structure.

In sum, the results in this chapter suggest the following conclusions, which in turn can contribute to the policy debate. First, with respect to the competition-stability and competition-fragility hypotheses there is no simple answer. However, there is a clear distinction depending upon the measure of risk, with the competition-stability

view supported in loan portfolio risk and competition-fragility in total risk. This would appear to suggest that competition is beneficial in ensuring a well-functioning loan market, competitive interest rates and lower default; but harmful as a whole where competition may prevent banks for obtaining and maintaining sufficient buffers against bad shocks. Second, large banks appear to be less affected by market structure but are more affected by economic conditions. This may arise as such banks are engaged in, for example, investments or merger activity and large scale loans which are more cyclical in nature.

Table 6.4. Empirical Results for Bank Risk and Market Structure - By Size

	Non-Performing Loans/Total Loans				Z-Score				Equity/Assets			
	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q	1 Q	2 Q	3 Q	4 Q
Average Value	0.012	0.010	0.011	0.006	0.44	0.44	0.45	0.35	0.162	0.161	0.161	0.124
Mkt Struc.	-1.6* (-5.9)	-1.2* (-6.1)	-0.9* (-3.4)	-0.23 (0.58)	-14* (-8.1)	-34* (-8.5)	-6.52 (-1.5)	-1.90 (-0.4)	-15* (-2.6)	-17* (-3.3)	-40* (-3.5)	-1.32 (-0.8)
Mkt Struc ²	2.99* (6.30)	1.57* (5.24)	1.14* (3.21)	0.36 (1.15)	26.3* (8.78)	51.1* (9.39)	3.74 (1.68)	4.68 (0.84)	25.4* (2.60)	27.9* (3.59)	54.6* (3.29)	1.21 (1.01)
Loans/ Assets	-0.23 (-1.5)	0.03* (3.82)	0.04 (0.39)	-0.01 (-0.4)	1.22* (3.59)	1.84* (2.69)	-0.23 (-0.6)	0.06 (0.38)	0.48 (1.95)	-0.10 (-0.1)	0.366 (0.60)	0.006 (0.06)
Non-Int/Tot. Inc	1.34* (3.38)	-3.30 (-1.0)	-0.01 (-0.2)	0.001 (0.07)	-2.7* (-2.5)	-5.2* (-3.7)	-0.04 (-0.7)	0.005 (0.96)	3.21* (4.81)	-14* (-7.7)	-0.03 (-0.4)	0.002 (0.56)
Size	0.15* (2.10)	0.66 (1.04)	0.039 (1.0)	-0.01 (-0.4)	0.64* (2.06)	-1.6* (-2.7)	0.51* (2.97)	-0.4* (-2.8)	0.4* (2.43)	0.96* (2.06)	0.27 (1.06)	-0.1* (-2.7)
Growth	-0.4* (-4.1)	-0.2* (-4.5)	-0.6* (-7.5)	-0.01 (-0.5)	-1.1* (-5.9)	-1.9* (-5.9)	-2.8* (-8.9)	-0.3* (-2.7)	-1.6* (-7.9)	-0.9* (-4.3)	-3.9* (-15)	-0.1* (-3.3)
GDP Gr.	-0.4* (-3.1)	-0.2* (3.98)	-0.7* (-5.5)	-0.25 (-4.7)	-9.6* (-4.4)	-18* (-5.1)	-8.6* (-3.9)	-7.1* (-7.6)	-11* (-5.6)	-17* (-4.6)	-9.3* (-2.9)	-3.4* (-6.6)
R-sq.	0.15	0.06	0.11	0.61	0.15	0.21	0.25	0.40	0.46	0.09	0.11	0.47
Q1	0.04	0.03	0.00	0.04	0.84	0.04	0.00	0.05	0.01	0.01	0.00	0.05
Heter.	0.06	0.75	0.36	0.12	0.64	0.25	0.18	0.26	0.03	0.03	0.05	0.08

Notes: 1 etc Q refers to the first etc quartile by size (total assets). Entries are coefficient values for the modelling approach given by equations (6.1) to (6.5) and related text where the dependent variable is a proxy for risk given by the ratio of non-performing loans to total loans, the Z-score or the equity-to-assets ratio. From equation (6.1) market structure is given by the Lerner Index. Bank controls are given by Non-Int/Tot. Inc, which is non-interest income to total income and measures diversification, size (total assets) and growth (change in total assets). Business environment is given by the change in GDP. Numbers in parentheses are *t*-values robust to autocorrelation and heteroscedasticity. * indicates 5% (or higher) statistical significance. The estimation sample is 1984 to 2009.

6.5. Summary and Conclusion.

The purpose of this chapter is to examine the relationship between bank competition and risk. The analysis examines the impact of market structure on US bank risk, in a panel setting, for the period 1984 to 2009. Furthermore, we examine the impact of regulatory change on the risk in banks, via the inclusion of a dummy for the 1999 Financial Modernisation Act, which effectively repealed the 1933 Glass-Steagall Act. The focus of regulatory impact on banks' risk is confined to the 1999 Act, in an attempt to determine whether the effective repeal of the 1933 Act was directly responsible for the increased risk that banks undertook. The relationship between competition and the fragility of banks in terms of the amount of risk is an important issue to consider within banking. That is, the competitive environment within which banks operate is key to determining the levels of risk that banks may be free to under-take. If banks engage in excessive risk taking, the negative consequences may be far-reaching throughout the entire economy, as the potential for bank failure undermines public confidence in the system as a whole. Thus the collapse of a single bank may lead to the collapse of other banks creating huge instability throughout the entire banking industry, given the pivotal role that banks play. Furthermore, fragility within the banking sector may potentially affect banking markets in other economies, given the global interbank nature of banking today.

Using a fixed effects panel estimator we consider the effect of market structure, as measured by the HHI and Lerner index, as well as other variables such as bank liquidity, diversification, size, growth and GDP growth on three measures of bank risk. Specifically, we examine loan risk (ratio of non-performing loans to total loans), the Z score, as a measure of overall risk and the equity-to-assets ratio, which measures the

extent of capital buffer held by the bank. In addition to the issues discussed above, it is hoped that the results here will also contribute to the literature on the competition-stability and competition-fragility hypotheses. That is, whether increased competition results in banks taking greater risks or whether it engenders greater stability within the banking sector.

The results presented here suggest that there is a difference in the nature of the relationships between loan risk and other measures of risk. Specifically, the results for loan risk appear to support competition-stability hypothesis, whereby, increased competition leads to a lower level of non-performing loans. In contrast, increased competition leads to lower Z score values (greater risk) and lower equity-to-asset ratios. This appears to suggest that banks view the risks associated with different aspects of bank behaviour differently. That is, where increased market concentration leads to greater credit-risk but lower overall risk and greater capital buffers. The implication therefore, is that competition policy needs to be fine-tuned for different aspects of bank behaviour and while increasing competition in the retail aspects of banking may be beneficial, it is not necessarily true that this will hold in all aspects of bank behaviour.

Building upon this result, however, there appears to be a key distinction between small and medium sized banks on the one hand and large banks on the other. More specifically, while small banks demonstrate a large response to market structure the basic relationship is similar to that of medium sized banks and as discussed above. However, the risk of large banks appears to exhibit no relationship with market structure, suggesting that competitive pressures per se do not affect risk. The risk behaviour of such banks is predominately affected by the state of the economic cycle,

while it is also noticeable that they are characterised by riskier behaviour overall, with a lower Z score and equity-to-asset ratio than other sized banks.

Finally, across all categories of banks, GDP growth is an important factor. In particular, positive economic growth is associated with lower loan risk but increased overall (z-score) risk and lower equity-to-asset ratios. The results of this analysis, suggest that there remains a role for policy-makers in controlling bank risk, but that it is not purely achieved through changing market structure, but rather also through perhaps altering requirements to coincide with different phases of the economic cycle.

Chapter 7. Summary and Conclusion.

This thesis has undertaken an extensive empirical analysis of the effects of competition on US bank profit and risk. Understanding competition within the banking sector is of great importance because it is argued that competition encourages greater efficiency, which is an important factor in determining economic growth. However, on the other hand it can be argued that too much competition could potentially create more instability in the banking sector. In particular, this thesis sought to examine several hypotheses regarding the nature of profit and risk within US commercial banks. First, we wish to consider whether US bank profits exhibit any persistence relative to industry average profit. That is, in a competitive market any such abnormal profits should lead to entry or exit with profits exhibiting little, if any, persistence. Second, and related, the thesis has sought to examine whether such persistence in bank profit is affected by regulatory changes that were designed to enhance competition. Such Acts should reduce the level of persistence within abnormal profit. Third, we wished to consider a broader exercise that examined whether bank profit persistence varies over time. Given continued technological change within the bank sector as well as movements in the economic cycle it, might be hypothesised that persistence will change as banks increase or decrease market share, or as industry level concentration changes. The final hypothesis sought to consider the competition-stability and competition-fragility hypotheses within bank risk. Particularly, the thesis sought to consider whether different measures of risk were affected differently by competition. This chapter continues by summarising each chapter and highlighting the key results in answer to these hypotheses.

In Chapter 2 we sought to provide an overview of the structure and performance of the US banking system, from the creation of the First Bank of the United States in 1791, the evolution of the unique dual banking system, to the current banking environment which is heavily regulated by extensive interventionary government policy. We discussed the evolution, and impact on banks' behaviour, of key regulatory changes. Legislation aimed at reducing competition was first introduced in response to the Great Depression during the 1930s and remained in place until the 1980s when the process of deregulation commenced. During the 1980s and 1990s a large number of mergers and acquisitions subsequently occurred, which both dramatically increased the size of the largest US banks enabling them to compete globally, as well as drastically reducing the overall number of US banks. This period was also characterised by a large volume of new bank charters. The impact of technological advances (for instance the creation of the ATM) and financial innovation (new financial tools such as MMMFs and securitised lending) on the banking sector is also reviewed. Banks became more diversified and were able to generate their income from other areas in addition to the traditional fee-based activities, as well as being able to operate more efficiently and expand their operations geographically. Finally, this chapter examines the impact of the 2007 financial crisis on the US banking industry, including the extent of government intervention and the introduction of new legislation.

In the third chapter we reviewed the literature regarding competition in banking. This is presented in three sections. The first section considers those studies which adopt the Structure Conduct Performance (SCP) approach to banking. These studies analyse the extent of competition within a given market based on the assumption that a link exists between the structure of a market and the conduct and performance of the firms

and industries within it, such that greater concentration leads to greater individual market power for big banks which results in more anti-competitive behaviour. In response to the shortcomings of this approach, the Chicago/Revisionist critique was subsequently developed in the 1970s. Central to this critique is the efficiency hypothesis which argues that big banks make large profits because they are more efficient. Therefore, the high prices or profits associated with higher concentration levels, is indicative of more efficient performance rather than effective collusion by banks. The next section considers those studies which adopt the New Empirical Industrial Organisation approach to banking whereby the focus is on bank level rather than industry level conduct/strategy. These studies attempt to analyse the response of prices (and in some instances quantities) to changes in competitive conditions, from which the extent of competition or collusion within a market can then be inferred. Breshnan-Lau and Panzar-Rosse are the two main techniques used in the NEIO studies.

In Chapter 4, the first of the empirical chapters, we examine both the influence of the two main regulatory acts, as well as the 2007 financial crisis, on the persistence of U.S. commercial banks' profits for the period 1976 to 2009. The dynamic examination of profits and profit persistence is undertaken via the use of panel estimation techniques including fixed effects and GMM. As noted above, there are two key hypotheses considered in this chapter. First, whether abnormal profits exhibit persistence, which would indicate some impediment to the competitive process; second, whether deregulatory acts designed to enhance competition reduce persistence. Our results indicate that first, banks exhibit significant positive persistence thus indicating such impediments to the competitive process; and second, this persistence varies over time with the regulatory changes. That is, coefficient results based on a first-order

autoregressive parameter for profits are both positive and statistically significant. This suggests persistence in abnormal profits in contrast to a purely competitive market where such abnormal profits would quickly disappear. Nonetheless, the parameter is relatively small in magnitude indicating that competitive pressures within the market are relatively strong. With regard to the effects of deregulation, persistence increased following the 1999 Act (indicating that competitive pressures had eased as diversification opportunities afforded by the act allowed banks to retain more profit) and decreased following the 1994 Act (suggesting that the act was successful in enhancing competition). Overall our results indicate that the legislation designed to enhance competition in the US banking sector appears to have had opposing effects, thereby affecting profit persistence in a way which might not always be expected.

Chapter 5, the second of the empirical chapters, examines the presence and source of time-variation within the profit persistence parameter and what factors determine any such variation. Knowledge of whether persistence varies over time and the factors that may cause persistence to change would be useful to policy-makers in designing regulation to enhance competition. In order to establish whether profit persistence exhibits time variation, rolling fixed window and expanding recursive window regressions for the persistence parameter are considered. The results reveal substantial time-variation, with persistence declining in the late 1980s and increasing in the late 1990s and early 2000s. Furthermore, we noted that during the financial crisis period persistence also declined. To further examine the existence of time-variation in profit persistence, this chapter also considers some simple non-linear threshold regressions. In particular, we considered four different threshold variables: lagged profit, lagged GDP growth, lagged fitted profit from a regression and lagged ratio of

non-interest income to total income. These were run for all banks and also separated by bank size. The results for these regressions were largely supportive of time-variation as the persistence parameter does indeed vary over different regimes of behaviour. In particular, we find that competitive forces impact less on banks when GDP is growing, as banks are more diversified and when banks are more profitable. This appears to hold true for most bank size categories with the key exception of large banks, for which it is noted that persistence is higher with a lower degree of non-interest income to total income. This may be indicative of a tendency towards over diversification by large banks, thereby contributing to the volatility of their profits.

Having demonstrated the presence of time-variation within persistence, we next consider bank specific, market structure and economic environment factors, in order to determine what influences affect such time-variation. Two key results uncovered were first, that all three influences just mentioned impact upon time-variation; second, that there is noticeable time-variation within the effect of these different factors on persistence. Due to the substantial variation in results over time it is difficult to succinctly summarise them; however overall, and from a policy perspective, the results suggest that where profit persistence is a proxy for the outcome of market competition, the relationship between competition and bank and market factors is complex. Furthermore, the results highlight the importance of economic growth on persistence and thus the resultant influence on the competitive nature of the market. Given our results also indicate the absence of a simple relationship between bank variables, market variables and persistence (all variables considered by policy-makers in the aftermath of the recent financial crisis), we also highlight the importance of accounting for the

variable nature of this relationship across different banks and through time when considering any policy implementation.

In the final of the empirical chapters, Chapter 6, we examine the relationship between bank competition and stability and consider the impact of regulatory change on the risk-taking behaviour of banks via the inclusion of a dummy for the 1999 Financial Modernisation Act. Using a fixed effects panel estimator, we examine the effect of market structure, as measured by the HHI and Lerner Index, in addition to other variables (such as bank liquidity, diversification, size, growth and GDP growth) on three measures of bank risk; namely loan risk, the Z-Score and the equity to assets ratio. Our results suggest that there is a difference in the nature of the relationships between loan risk and other measures of risk. That is, the results for loan risk suggest that increased competition leads to a lower level of non-performing loans, in contrast to lower Z-scores (greater risk) and lower equity to asset ratios. This would appear to suggest that banks view the risks associated with different aspects of bank behaviour differently and as such, increased market concentration leads to greater credit-risk taking behaviour but lower overall risk and greater capital buffers. Therefore, in terms of policy implications, our results highlight the fact that while increasing competition in the retail aspects of banking may be beneficial, it does not necessarily follow that all aspects of bank behaviour will benefit. Thus there exists an argument for fine tuning competition policy to accommodate the different aspects of bank behaviour. Our results also suggest that there is a key distinction between small and medium sized banks on the one hand and large banks on the other; that is, there appears to be no relationship between large banks' risk-taking behaviour and market structure, implying that

competitive pressures per se do not affect their risk-taking, but rather it is predominantly affected by the economic cycle.

Overall, the implications and contribution of this thesis lie in establishing evidence for the persistence of abnormal profits in US commercial banks and that the persistence varies with regulatory acts and more generally with bank and market specific factors as well as the business cycle. Furthermore, that there exist differences between banks of different size with respect to the extent of persistence and the conditioning factors. Understanding the movement and causes of bank profit persistence has obvious implications for the conduct of policy and its attendant implications for the nature of market competition. Further, the implications and contribution lie in the analysis of different types of bank risk and how they relate to competition in respect of the competing competition-stability and competition-fragility hypotheses. Noticeable differences are reported according to bank size. Again, this has implications with respect to the implementation of policy and the need for regulation to differ among different bank types. In terms of the Dodd-Frank regulation, the key components with respect to this thesis concern the increase in capital, liquidity and risk requirements, the monitoring of ‘too big to fail’ banks and the Volker rule that limits speculative trading by banks. The results presented here suggest that no simple relationship exists between competitive pressure and risk on the one hand and bank size and market concentration on the other. An increase in equity buffers is consistent with reduced risk, but the results show that increased competition leads to lower buffers and increased risk. Further, that the nature of these relationships differ across bank size. Similarly, that an increase in bank growth share does not necessarily reduce competitive pressures as this can make markets more contestable. Finally, following the adoption

of universal banking there is no substantial evidence to suggest this has increased risk in the banking sector.

Nonetheless, further work along these research lines could further illuminate the debates regarding competition, profit and risk. The first two empirical chapters reveal that there is evidence of profit persistence in US commercial banks, that persistence changes with regulatory regimes and that persistence is time-varying. With regard to future research several issues remain. Along one such research avenue, we could seek to extend the evidence base with respect to these issues through examining international evidence, both in terms of time-variation and the effects of regulatory change. Indeed, as this work is perhaps the first to examine time-variation in bank profit persistence in this manner, further evidence is required in examining the nature and cause of variation. Furthermore, where differences are identified along the lines of bank size, this work could be further extended by, for example, using finer definitions of bank size. Another potential avenue of interest would be to examine the components of the profit measures considered here. That is, the ROA and ROE measures are constructed as a ratio of net income to total assets or total equity. Individually, we would expect such measures to contain a unit root and thus for the ratio to exhibit low persistence there must be a cointegrating relationship. Thus, periods of higher persistence indicate a temporary movement away from the cointegrating relationship and it would be of interest to examine whether this occurs primarily through changes in net income or total assets or equity.

The third empirical chapter examines the issue of risk and those factors that may affect bank risk and notably market structure. Results indicate some differences between types of risk, e.g., loan risk versus overall Z-score risk, as well as according to

bank size. Further evidence for the existence of these distinctions could be sought by considering different markets and time periods. Furthermore, different measure of risk could be considered or an attempt to measure the risk of different parts of banks operation could be considered, e.g., issues relating to liquidity risk or investment portfolio risk. Extending this, as variables considered in this study are accounting based, thus, the use of market based variables could be considered. In examining bank performance and risk, where available, we could use share price information or the market risk measures such as CDS spreads. Further, as with the profit measure, the Z-score is a ratio containing profits (ROA or ROE), the equity to assets ratio and the standard deviation of profit. While, we examine the behaviour of earnings and equity to assets, we could extend this research by also examining the volatility of bank earnings and those factors that affect its movement. That is, we could consider whether the volatility of bank earnings is related to bank size and/or market structure as measured through concentration or market power. Again, an understanding of the nature of such relationships could help with the conduct of regulation. Further, as noted in Chapter 6, we could follow Köhler (2014) and extend the analysis (across all chapters) to examine the effects of competition and market structure on different bank types.

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